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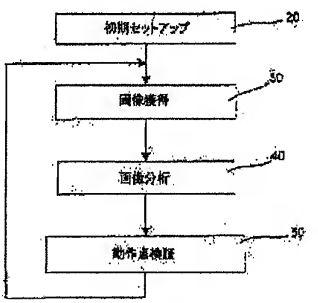
(54) METHOD FOR AUTOMATICALLY ADJUSTING CHARACTERISTIC VARIABLE IN OPTICAL CODE READ SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a method for automatically adjusting the characteristic variables of an image which is especially suitable for the case that the changing speed of the various characteristics of continuing images is high by detecting the characteristic variables of an image, and correcting a controlled parameter acting on the variation of the measured characteristic variables when a read operation is completed.
SOLUTION: The selective step of the initialization of a parameter is obtained at first (20). Next, an image including optical codes to be checked is obtained (30). Then, the obtained image is analyzed (40). At last, whether or not it is necessary to change the operating point of a read system (applied by one set of the present values of the control parameter) is judged so that initial self- learning can be attained, and the dynamic variation of the read system can be monitored (50). Thus, statistical quality examination related with plural preceding images can be attained, and continuous capture suitable for the secular variation of outside and inside conditions can be optimized.



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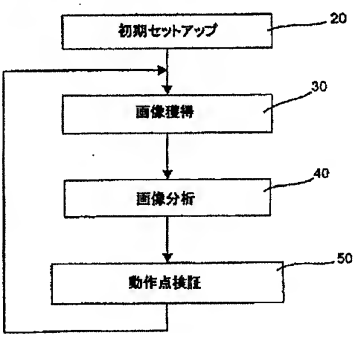
(54)【発明の名称】　光符号読み取りシステムにおける特性変数の自動調節方法

(57)【要約】
【課題】　光符号読み取りシステムにおいて、連続する画像の諸特性の変化速度が高い場合に特に適合する、特性変数の自動的な調節方法を提供すること。
【解決手段】　本発明による方法は、画像を獲得するステップと、この獲得された画像中に少なくとも１つの光符号を読み取ることを試行するステップと、読み取りが成功であった場合にだけ、この獲得された画像の特性分量を検出するステップと、様々な画像を獲得する動作を何回も実行して、特性分量に付いての重要な統計データを得るステップとを含む。光学系の制御パラメータはこの検出された統計データに基づいて修正され、これによって読み取り値を最適化する。この制御パラメータの値は操作されている間に連続的に調節され、これによって読み取りシステムの特性の変動を監視する。



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【特許請求の範囲】

【請求項１】　光符号読み取りシステムにおける少なくとも１つの特性変数を自動的に調節する方法において、画像を獲得するステップａと、
前記画像中の少なくとも１つの光符号を読み取ろうと試行するステップｂと、
前記読み取り動作が成功裏に完了したか否か検証するステップｃと、
完了したと検証された場合、前記画像の前記特性変数を検出するステップｄと、
前記測定特性変数の変動に作用する少なくとも１つの制御されたパラメータを修正するステップｅとを含むことを特徴とする方法。

【請求項２】　前記ステップａ乃至ステップｄが繰り返し実行され、これによって、複数の画像のための統計データを獲得し、また、少なくとも１つの特性パラメータを修正する前記ステップｅが前記統計データに基づいて実行されることを特徴とする請求項１記載の方法。

【請求項３】　前記少なくとも１つの制御パラメータを前記ステップａ乃至ステップｅまでを繰り返し実行することによって連続的に調整することを特徴とする請求項１又は２記載の方法。

【請求項４】　前記パラメータが最小値と最大値の間の分量だけ修正され、前記最小値は、前記検出された特性変数の変動を評価することを可能とするような値であり、前記最大値は、検証する前記ステップｃがプラスの成果を有するような値であることを特徴とする請求項３記載の方法。

【請求項５】　連続的に調整する前記ステップが、読み取りが実行される毎に実行されることを特徴とする請求項３又は請求項４記載の方法。

【請求項６】　連続的に調整する前記ステップが所定の回数だけ読み取りが実行される毎に実行されることを特徴とする請求項３又は請求項４記載の方法。

【請求項７】　前記特性変数が画像輝度と焦点合わせ品質から選択されることを特徴とする請求項１乃至請求項６のいずれか一項記載の方法。

【請求項８】　少なくとも１つの特性変数を検出する前記ステップが、最大輝度、最小輝度、平均輝度、輝度信号エネルギ、符号要素の幅変動及び光符号の変形の現時点の値を測定するステップを含むことを特徴とする請求項１乃至請求項７のいずれか一項記載の方法。

【請求項９】　前記少なくとも１つの制御パラメータが焦点合わせ位置、画像獲得感度、照明出力、読み取り決定閾値及び画像走査速度から選択されることを特徴とする請求項１乃至請求項８のいずれか一項記載の方法。

【請求項１０】　少なくとも１つの特性変数を検出する前記ステップｄが、
前記画像の領域からウインドウを抽出するするステップと、

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前記ウインドウ中の前記特性変数を獲得するステップとを含むことを特徴とする請求項１乃至請求項９のいずれか一項記載の方法。

【請求項１１】　前記ウインドウが前記領域に対して中心に配置されることを特徴とする請求項１０記載の方法。

【請求項１２】　読み取りを試行する前記ステップｂが、光符号を包含する領域を前記画像中に局所化するステップを含むことを特徴とする請求項１０又は請求項１１記載の方法。

【請求項１３】　少なくとも１つの制御パラメータを修正する前記ステップｅが、前記制御パラメータが前記特性変数に対して単調な関係を有するか否か検証するステップを含むことを特徴とする請求項１乃至請求項１２のいずれか一項記載の方法。

【請求項１４】　前記少なくとも１つの特性変数が所定の間隔に収まっているか否か検証するステップと、
そうでない場合に前記制御パラメータを修正するステップとを含むことを特徴とする請求項１３記載の方法。

【請求項１５】　前記制御パラメータの中心値を獲得するステップと、
前記中心値に第１の所定の分量だけ増分させることによって得られる、前記制御パラメータの第１の修正値を決定するステップと、
少なくとも１つの成功裏に読み取られた画像を獲得するステップと、
前記少なくとも１つの第１の画像から、前記特性変数の第１の特性値を獲得するステップと、
前記中心値から第２の所定の分量だけ減少させることによって得られた、前記制御パラメータの第２の修正値を決定するステップと、
少なくとも１つの成功裏に読み取られた画像を獲得するステップと、
前記少なくとも１つの第２の画像から前記特性変数の第２の修正値を獲得するステップと、
前記特性変数の前記第１の修正値が前記第２の特性値より良好である場合には、前記制御パラメータの前記中心値を、前記制御パラメータの前記第１の修正値に対して相関的に変更し、そうでない場合には前記制御パラメータの前記中心値を、前記制御パラメータの前記第２の修正値に対して相関的に更新するステップとを含むことを特徴とする請求項１４記載の方法。

【請求項１６】　前記第１と第２の所定の分量が互いに等しいことを特徴とする請求項１５記載の方法。

【請求項１７】　前記第１と第２の分量が、前記特性変数の測定可能な変動を生じるに十分大きく、光符号の読み取り可能性に影響しない程度に十分小さいことを特徴とする請求項１５又は請求項１６記載の方法。

【請求項１８】　中心値を獲得する前記ステップの後に、

少なくとも１つの第３の成功裏に読み取られた画像を獲得するステップと、

前記少なくとも１つの第３の画像から前記特性変数の第３の特性値を獲得し、前記特性変数の前記第３の特性値が前記第１と第２の特性値より良好である場合、前記中心値は更新されないステップとを含むことを特徴とする請求項１５乃至請求項１７のいずれか一項記載の方法。

【請求項１９】　特性変数を検出する前記ステップがテーブルを記憶するステップを含むことを特徴とする請求項１３乃至請求項１８のいずれか一項記載の方法。

【請求項２０】　前記記憶ステップが、少なくとも１つの特性変数を検出するステップが実行される毎に、前記特性変数の獲得されたサンプル番号と前記特性変数の平均値を更新するステップを含むことを特徴とする請求項１９記載の方法。

【請求項２１】　少なくとも１つの特性変数を検出するステップが実行される毎に、前記記憶ステップが各動作状態に対する前記テーブルの個々のフィールドを更新するステップを含むことを特徴とする請求項１９又は請求項２０記載の方法。

【請求項２２】　少なくとも１つの制御パラメータを修正するステップが、前記特性変数の前記獲得されたサンプル番号と前記平均値をリセットするステップをさらに含むことを特徴とする請求範囲第１９乃至請求項２１のいずれか一項記載の方法。

【請求項２３】　複数の特性分量を含み、また、特性変数を検出する前記ステップが各特性変数に対するテーブルを記憶するステップを含む、ことを特徴とする請求項１９乃至請求項２２のいずれか１項記載の方法。

【請求項２４】　前記ステップａからステップｅの前に、自己学習をして、前記少なくとも１つの制御パラメータの初期近似値を設定するステップを実行することを特徴とする請求項１乃至請求項２３のいずれか１項記載の方法。

【請求項２５】　前記自己学習ステップが、

前記制御パラメータの試験値を持つ画像を獲得するステップｆと、

前記画像中の少なくとも１つの光符号を読み取ることを試行するステップｇと、

前記読み取り動作が成功であった場合、前記自己学習ステップを遮断して前記ステップｄ及びステップｅを実行するステップｈと、

前記読み取り走査が不成功であった場合、以前には使用されていなかった新しい試験値を持つ前記制御パラメータの前記試験値を修正するステップｉと、

前記ステップａ乃至からステップｈを繰り返し実行するステップｊとを含むことを特徴とする請求項２４に記載の方法。

【請求項２６】　少なくとも１つの制御パラメータを修正する前記ステップの後で、

前記制御パラメータが許容可能な値を有しているか検証するステップと、

有していない場合、警告信号を発生するステップとを実行することを特徴とする請求項１乃至請求項２５のいずれか１項記載の方法。

【発明の詳細な説明】

【０００１】

【発明が属する技術分野】本発明は、光符号読み取りシステムの特性を自動的に調節する方法に関する。

【０００２】

【従来の技術】以下において、「光符号」という用語は、コーディングされたデータを記憶する機能を有する図形表示を意味する場合に用いる。光符号の特定の例には、線形符号又は２次元符号が含まれるが、この場合、データは、バーコードやスタック化符号（ＰＤＦ４１７を含む）、マキシコード（Ｍａｘｉｃｏｄｅ）、データマトリックス（Ｄａｔａｍａｔｒｉｘ）、ＱＲ符号、カラー符号などの明るい要素（通常は白色のスペース）によって分離された暗色の（通常は黒色の）、所定の形状、例えば正方形、長方形又は六角形を持つ要素を適切に組み合わせたものによってコーディングされる。

【０００３】「光符号」という用語は、さらに、より一般的に、非コーディングキャラクタ（文字、数字など）と特定のパターン（スタンプ、ロゴ、署名など）を含む。これらの情報はまた、３つ以上の色、例えば灰色色調でコーディングされることがある。

【０００４】光符号は、符号が存在することになっており、また、画像内の符号を局所化することが期待されているような領域で２次元画像を獲得することによって読み取ることが可能である。

【０００５】一般に、符号局所化には、直前に記憶された画像内で、少なくとも１つの符号が存在する１つ又は複数の領域を最初に区別するステップと、次に、各符号に対して特定の認識パターンを局所化するステップと、実際の符号タイプに関するデータを獲得するステップと、最後に、符号を正確に区切るステップとから成る１連のステップが必要である。この後で、この区切られた符号画像は、デコーディングに必要な特徴を抽出する目的で処理されて、最終的に、この符号は必要なデータを抽出するためにデコーディングされる。

【０００６】特に、デコーディング操作は、データが抽出されて正確であると認識されて始めて正確に完了したと言えるが、逆に、処理システムがどのデータの抽出にも成功しない場合や、抽出されたデータが正確である確率が不十分である場合や、抽出されたデータが必要とされるデータに対応していない場合は、それは否定的に完了したことになる。

【０００７】読み取りが成功する確率はいくつかの要因に依存するが、その内の一部のものは、読み取りシステムの外部の問題（例えば読み取られる光符号の品質な

ど）であり、他のものは読み取りシステムの光電気／機械的パラメータによるものである。

【０００８】事実、どんな読み取りシステムでも、他の物理的システムと同様に、個々の被検査物によって、設置のタイプや時間に関する可変の特性を有している。特に、読み取りシステムの特性は、特定の公差（広がり）内で変化する特性を有する、被検査物を構成する個々の構成部品によって異なる。加えて、多くの構成部品はその特性が、その外部条件（例えば温度）が変化するに連れて変化し、経時劣化する。

【０００９】これらの問題を解消するために、製造と設置の双方の間で用いられる較正方法が周知であるが、それに加えて、自動的に又はオペレータ制御され、関連のシステムが作動している間に効果を持つ調節方法が周知である。

【００１０】無遮断運動している物体を読み取る光符号読み取りシステムにおいては、特性を調節するのは特に困難であるが、その理由は、基準画像や、極めて迅速に獲得される画像の特性に集中するのが不可能であるからである。

【００１１】既存の問題をよりよく理解するために、図１を参照すると、参照番号１で総称される一般的な光符号読み取り装置が備えているコンベヤベルト２が、この場合はバーコードである光符号４を担持している物体３を指示しているところが示されている。

【００１２】コンベヤベルト２は光エンコーダ５と結合していて、物体３の速度を測定するようになっており、加えて、コンベヤベルト２の一方の側には、存在センサー６と高さセンサー７が置かれている。

【００１３】コンベヤベルト２の上方には、感知領域１１を有し照明部品１２を指示している画像獲得デバイス１０が配置されており、画像獲得デバイス１０はまた、オプションとして画像獲得デバイス１０に組み込むことも可能な、この場合はパソコンで表されている処理ユニット１３に接続されている。

【００１４】図１に示すタイプのシステムが正確に作動するには、照明部品１２と処理ユニット１３の画像獲得デバイス１０の多くのパラメータを正確に設定することが必須である。特に、光符号読み取りシステムにおいては、必須の特性には画像焦点合わせと輝度があるが、他の重要な特性には、印刷及び／又は遠近現象によって引き起こされる、例えば読み取られる物体の見かけ上のディメンジョンと光符号の固定変形がある。これらの特性は直接的に又はある種の物理量を測定することによって検出することが可能である。例えば、画像の焦点合わせは画像獲得デバイス１０から供給されるアナログ信号又はデジタル信号のエネルギを測定することによって検出可能であるが、その理由は、周知なように、ボケた画像は輝度勾配が低く従ってエネルギも低いからである。

【００１５】読み取りシステムの諸特性、従って対応する測定量は、読み取りシステムの複数のパラメータの値に依存する。例えば、調節可能なパラメータの中で以下のものが重要である。自動焦点合わせデバイスの位置、画像獲得デバイス１０の感度（すなわち、感知領域１１内に生じた電気信号を獲得して初期処理を実行するデバイス１０内の回路の利得）、照明デバイス１１によって放射される出力（すなわち、照明部品１２に与えられるされる供給電圧）、調べられる物体の走査速度（外部的に設定されるが、コンベヤベルト２の移動速度に依存する）、および、例えば特定の電圧レベルが「白」又は「黒」に対応するかどうかを判断するデコーディング処理に必要な閾値である。

【００１６】さらに、これらのパラメータ（例えは、自動焦点合わせデバイスの位置、テレビカメラの照射出力及び感度）のいくつかの最適値は、画像獲得デバイス１０に対する物体の高さに依存する。

【００１７】（例えばテレビのショットのように）次々と獲得される画像が互いに少しずつ異なる読み取りシステムにおいて、これらのパラメータを最適化する問題はすでに様々な方法によって解決されている。例えば、全ての市販のテレビジョン用テレビカメラは自動的な利得制御機能を有しており、様々な照明条件に適合することが可能である。テレビカメラは、得られた最新の画像を解析することによって、その画像と大きく異ならないと考えられる次の画像を獲得するための感度に自らを適合させることが可能となる。同様に、全ての市販テレビカメラは、最新の取得画像を（例えば色収束に基づいて）解析する自動焦点合わせデバイスを有している。

【００１８】実際には、最良の画像品質を迅速に得るためにフィードバックメカニズムが用いられる。

【００１９】

【発明が解決しようとする課題】しかしながら、画像特性の変化速度が大きくなりすぎて獲得速度と比較できなくなる場合には、すなわち連続して獲得される画像が互いに全く相違しかねない場合には、上述のフィードバックメカニズムはもはや機能しない。このような場合には、次の画像の特性がテレビカメラに現れることを予測して、獲得パラメータの全てを前もって最適化することが必要である。

【００２０】例えば物体及びテレビカメラ間の距離に関するデータ又はその平均輝度を予め供給する追加的なセンサーを用いることによって、予測能力を高めることができるが、この方法では十分でない場合が多い。

【００２１】例えば、ランプの経時劣化に起因する照明の変化は、単に、獲得すべき物体の平均測定輝度値を算定することによっては、測定できない（またそのため補正できない）。暗い物体が極端に長く続いた場合、照明ユニットが突然に経時劣化したものと判断されかねない。

【００２２】同様に、最適な焦点合わせ位置は、自動焦

点合わせ位置決めデバイス又は距離センサーの電気機械的な諸特性のゆらぎの影響で時間的に変動し得る。

【００２３】本発明の目的は、光符号読み取りシステムにおいて、連続する画像の諸特性の変化速度が高い場合に特に適合する、特性変数の自動的な調節方法を提供することにある。

【００２４】

【課題を解決するための手段】本発明に従えば、以下のステップで特徴づけられる光符合読み取りシステムの少なくとも１つの特性変数を自動的に調節するための方法が提供される。

【００２５】ステップａ　画像の獲得、

ステップｂ　その画像における少なくとも１つの光符合を読み取る試み、

ステップｃ　その読み取りが正確に完了したかどうかの検証、

ステップｄ　そうであった場合の、その画像についてのその特性変数の取得、

ステップｅ　その得られた特性変数の変動に作用する少なくとも１つの制御されたパラメータの変更。

【００２６】特性変数（または量）は数回にわたり適宜獲得されて、多数の読み取りについて平均的統計データが取得され、連続する画像間の実品質的相違が測定される。さらに、連続して調節が行われて、環境的原因又は内部の構成部品の変化に起因する読み取りシステムの特性の変動をモニターする。

【００２７】調節される特性の量には、画像輝度及び焦点合わせ特性が含まれ、制御パラメータは、焦点合わせ位置、画像獲得感度、照明出力、読み取りに用いられる判断閾値、及び画像走査速度の中から選択される。

【００２８】制御パラメータの夫々及び特性量の夫々の間の関係が知られていないときは、本方法は、現在の値からの、少なくとも、１つの小さな正の変位及び１つの小さな負の変位によって、現在のパラメータの値を変更して、その２つの変位のどちらがより良好な画像品質を与えるかを査定する。制御パラメータの新たな値は引く続く読み取りにおいて中心値となる。このプロセスを繰り返すことによって、制御パラメータの中心値は、直ちに最適な位置に向かって移動し易くなり、この位置の経時的ないかなる変動もモニターできる。

【００２９】本発明のさらなる特性が、全く非限定的な例証として与えられかつ以下の添付図面を参照して説明される好ましい実施形態の説明によって明らかとなろう。

【００３０】

【発明の実施の形態】本発明によって、読み取りシステムが特定の初期学習時間（その間読み取りシステムは正しく作動しているとは想定されない）だけ待機することが可能ならば、初期自己学習プロセスを用いて、光符合読み取りシステムのパラメータを初期設定することが可能となり、さらにまた、最適化された方法を用いて、パラメータ値を、周囲の環境及び内部の構成部品の経時的変化に適合させるための現在の調節を連続的に変更することが可能となる（自己調節）。

【００３１】特に、本発明に従う図２の実施形態において、まず最初に、パラメータの初期設定の選択的ステップがある（ブロック２０）。このステップは、手動であって、読み取りシステムが一旦取付けられた後に（又は、構成部品取り替えの保守中断の後に）行われるが、既に述べたように省略することができる。

【００３２】引き続いて、検査すべき光符合を含む画像が獲得される、ブロック３０。読み取りプロセスにおいて本品質的であるこの画像獲得は、読み取りシステムが作動開始するときの自己学習にとっても、また標準作動時における自己調節にとっても、本品質的である。画像獲得は全ての光符合読み取りシステムに特有のものであり、ＣＣＤ又はＣＭＯＳタイプの線形又はマトリックスセンサーを用いて周知の方法に従って行われ、画像を形成する各ドット（画素）の輝度レベルに関連するアナログ又はデジタルの電気信号を供給する。

【００３３】続いて、獲得された画像が解析される、ブロック４０。図３を参照して以下に述べられるこの解析は、画像内において現在の光符合（複数の光符合）を検索する目的、デコーディング又は認識を試みる目的、及び、肯定的結果が出た場合に、制御パラメータの調節に必要ないくつかの画像量を獲得して適切に記憶する目的を有する。

【００３４】最後に、（制御パラメータの現在値の１組によって与えられる）読み取りシステムの動作点を変更する必要があるかどうかが判断されて、初期自己学習が可能となり、又は読み取りシステムの動的変動のモニターが可能となる、ブロック５０。動作点変更ステップは図４乃至図９を参照して以下に説明されるが、それに引き続いて、ブロック２０に戻り新しい画像の獲得が行われる。

【００３５】獲得された画像を解析するステップ（図２のブロック４０）を図３を参照して説明する。詳述すると、最初に処理ユニット１３が、獲得され記憶された画像内で、光符合をおそらく含んでいる領域を検索する、ブロック７０。このステップは、例えば、画像内で最も大きなコントラストを持つ領域を探し求める周知の方法を用いて実行される。なぜならば、符合は、異なる色（例えば白及び黒）を持つ要素又は構造によって形成されており、その色の特定の反復交替がコーディングの目的だからである。

【００３６】引き続いて、読み取りシステムは、少なくとも１つの符合領域が識別されたかどうかを検証する、ブロック７５、検証されなければ（ＮＯ出力）、解析ステップ４０は終了する、検証されれば（ＹＥＳ出力）、第１の（又は唯一の）識別符合領域が選択されて（ブロ

ック８０）、読み取りが試みられる、ブロック８５。読み取りの試みは、読み取られる符号のタイプに応じて周知の方法で実行される、特に、読み取られる符号がキャラクタを含んでいれば、読み取りは、十分に信頼できる方法におけるキャラクタ認識に基づいて行われる、バーコード又は二次元のコードが含まれていれば、読み取りは、十分に正確な方法による符合のコーディングから成る。例えば、バーコードの場合、通常用いられる方法に従えば、反復交替する一連の色の要素（バー）の有無が検証され、要素の数が結局１つの所定値に等しくなるかどうかが検証され、各要素の幅が測定され、その幅又は少なくともそれらのいくつかが所定の条件（例えば、それらが互いに関連するかどうか、又は所定の順序を持っているかどうか）を満たすかどうかが選択的に検証され、検出された要素の反復交替に対応する数の系列が決定され、そして得られた数の系列が条件に合う符合かどうかが判断される。

【００３７】続いて、読み取りが成功裏に完了したかどうかが検証される、ブロック９０。このステップは非常に重要である。何故ならば、符合読み取りの肯定的結果は、検討されている領域が測定量（本発明に従えば、それは、パラメータの値を調節するために用いられる統計的データを規定する）の現在値を獲得するために十分な品質をもっていることを示しているからである。実際、本発明に従えば、光符合の良好な読み取りを保証する画像領域のみが、パラメータの値を変更するために用いられる、他方で、読み取りができない又は十分に信頼できない領域は、得られた統計的データが正しいこと保証できないので、これらの領域は拒絶される。この結果、読み取りが起こらなければ（ブロック９０からのＮＯ出力）、同じ画像の検索ステップ７０において他の符合領域が検出されなかったどうかが検証される、ブロック９５、他の領域がなければ、ＮＯ出力がブロック９５から出されて、画像解析ステップ４０は終了する、そうでなければ（同じ画像内に他の領域が存在し、そこでは光符合の存在の可能性がある、ブロック９５からのＹＥＳ出力）、引き続く符合領域が選択され、ブロック１００、読み取りが試みられて、ブロック３５に戻る。

【００３８】読み取りが成功すれば（ブロック９０からのＹＥＳ出力）、前に識別された符合領域の１部が選択され、すなわち、具体的にはその領域は品質に関して最良だと見なされる。特に、デコーディングされる光符合の中央部分が適宜選択されて、エッジ効果を除去する（ウインドウ抽出のブロック１０５）。

【００３９】続いて、ちょうど選択されたウインドウが処理されて、統計的データ、すなわち測定量の値が獲得される、ブロック１１０。特に、このステップでは、全ての測定量が測定され計算される。それには例えば、最大輝度値（すなわち、灰色レベルとして測定される２色符合における白色のレベル）、最小輝度値（黒色レベル）、平均レベル、信号平均エネルギー、符合要素率の所定値からの偏差の全て、及び符合形状の変形の指標の全て、が含まれる。特に、０と２５５バイナリレベルの間に含まれる輝度スケール上で、適切な輝度条件においては、白色レベルは２００に近いバイナリ値であり、黒色レベルは１０に近い。さらに、信号エネルギは、輝度信号の導関数の振幅の平方として計算することができる。

【００４０】ちょうど計算された統計的データは、各変数について１つずつ、適切なテーブルに記憶される、ブロック１１５。この統計的データは、被検査物体及び画像獲得デバイス１０間の距離（その画像が検出された物体の高さから得られる）に応じて、別々に適宜記憶される。何故ならば、パラメータの最適値はこの距離によって決まるからである、さらに、これらのテーブルは、これまでに獲得されたサンプルの数、合計値、及び合計値をサンプル数で割って計算される平均値を記憶するのが好ましい。実際は、新規の獲得毎に、測定された値の各々について、また被検査物体の現在の高さの値に応じて、サンプル数が１つずつ増やされ、合計値が更新されて、新たに獲得された値が前の総計に加えられ、平均値が更新される。

【００４１】検討される測定変数、それに結合するパラメータ及び最適化される特性に依存して、２つの異なるタイプのテーブルが構成され、その詳細が図７及び８を参照して以下に説明される。

【００４２】統計的データテーブルが更新された後（ブロック１１５）、ブロック９５に関連して既に述べられたようにさらなる符合領域が画像内に存在するかどうかが検証され、存在しなければ、画像解析ステップ４０は終了する。

【００４３】動作点を検証するためのステップ５０を詳述する前に、本発明の方法従う読み取りシステムの特性を最適化するために、獲得された統計データに基づいてパラメータを調節するためのメカニズムが説明される。実際、（最大及び最小輝度値によって測定される画像輝度などの）いくつかの特性は、制御パラメータ（画像獲得デバイスの振幅利得及び照明部品１２の出力）の各々に対して（正確に又は少なくとも近似的に知り得る）単調的相関関係を有しており、例えばそれは、輝度Ｌ及び利得Ｇ間の関係を表す図４に示される。そのためこの場合、測定変数値（最小及び最大輝度値）に基づけば、読み取りを最適化するために、制御されるパラメータ値に施される補正を識別することは容易である。例えば、所定の獲得数の後に、特定の高さについて獲得された全ての符合領域が暗色（所定値、例えば１８０よりも低い最大デジタル化輝度値）であれば、利得を増大させ及び／又は照明出力（例えば、照明部品１２に供給される電圧）を増大させることが必要である。

【００４４】他方において、画像獲得デバイス１０によ

って供給される電気信号のエネルギーによって測定される焦点合わせ能力のような、他の特性は、制御パラメータの各々に対してより複雑な相関関係を有しており、それは例えば、自動焦点合わせデバイスの平均エネルギーＥと位置Ｐを結びつける関数を表す図５によって示される。この場合は、読み取りを最適化するために、測定変数と制御パラメータとを（たとえ近似的にでも）結びつける特定の法則を直接利用することは不可能である。実際、曲線が絶対最大値を持つ、図５に示すタイプの関数の場合には、以下の問題が存在する。

【００４５】最大値Ａの絶対値は画像から画像へと変動し、そのためちょうど獲得された画像が最良かどうかを判断することが不可能である、動作点が最大値の左側又は右側（図５において、同じ縦座標を有する点Ｂ又は点Ｃ）に位置するかを判断することが不可能であり、従って、読み取りを改善するために、焦点合わせ位置がどちらの方向に変動しなければならないかを決定することが不可能である。

【００４６】従って、制御パラメータの各々に非線型的に結合された測定量の場合には、本発明の方法従って、現在の設定について、好ましくは同じ値の正及び負の変化を伴う、制御パラメータの値をわずかに変更させた、特定数の獲得を実行することによって、読み取りシステムが置かれた湾曲点の識別が可能になるとともに、補正が必要かどうかの判断、及び実行される実際の補正の方向の選択的な決定が可能となる。例えば、図５に類似した図６を参照して、システムが、特定数の獲得に対して、位置Ｐ１及び平均エネルギーＥ１に対応する点Ｃに位置していれば、位置の値が、最初に例えば変位＋Ｊだけ変更されて、位置Ｐ２に移行し、こうして特定数の獲得の後に平均エネルギー値Ｅ２が得られる、それから初期値が変位－Ｊだけ変更されて、位置Ｐ３に移行し、こうして平均エネルギー値Ｅ３を得る。この場合、最適な読み取り条件は最大エネルギーレベルに対応するので、明らかに、第２の設定（－Ｊ）が最良の結果を与え、制御パラメータの中心値がこうしてＰ３に確定されなければならない。

【００４７】特に、変位Ｊの絶対値は、画像品質の変化が見極められるよう十分大きく、しかし光符合の読み取りが妨げられないよう十分小さくなければならない。この変位は、検出された特性変数の検証及び光符合の読み取りを可能にするような、最小値及び最大値間の間隔内で適宜選択される。なぜなら、自己調節測定は読み取りシステムの正常作動時に起こり、動作を最適化するための変位の方向が識別されていないので、最適な条件から離れて移動している変位についても読み取りシステムの機能は維持されなければならないからである。

【００４８】さらに、所定の変位に基づく制御パラメータの変更が、各獲得毎に、又は所定数の獲得毎に行われる。

【００４９】それから、単調的相関関係にある測定変数及び制御パラメータの場合には、データ記憶ステップ１１５において、図７のタイプのテーブルが適宜用いられる。そこでは簡略化のために、合計値の列は示されない、他方、非単調的相関関係にある測定変数及び制御パラメータの場合には、図８のタイプのテーブルが用いられる。そこでは、物体の高さの値の各々について、及び両変位＋Ｊ及び－Ｊについて、サンプル数Ｎ（－Ｊ）、Ｎ（＋Ｊ）、及び計算された平均エネルギーＥ（－Ｊ）、Ｅ（＋Ｊ）が示される。

【００５０】上述の説明に基づいて、動作点を検証し、選択的に変更するステップ（図２のブロック５０）が、単一の制御パラメータについて、図９を参照して説明される。しかしながら、ステップ５０は、読み取りシステムの制御パラメータの各々について、各画像解析ステップ４０の後に、繰り返される。

【００５１】最初に、ブロック１５０において、読み取りシステムが自己学習の状態にあるかどうか（被検査物体及び画像獲得デバイス１０間の現在の距離を含む検討すべき動作条件のための、読み取りを可能にする初期設定がまだ見出されていない）、又は良好な調節の状態にあるかどうかが検証される。第１の場合（ブロック１５０からのＹＥＳ出力）、現在の動作条件において、少なくとも１つの適正な符合読み取りが行われたかどうかが検証される（ブロック１５１）。そうでなければ（ブロック１５１からのＮＯ出力）、制御パラメータはまだ用いられていない値に設定される（ブロック１５０）。光符合のデコーディングまでに至っていない各獲得画像に対しての自己学習ステップの聞くりかえされるこのステップは、符合読み取りを可能にする設定が特定の動作条件中に見出されるまで、所定のスキームに従って、制御パラメータの可能な全ての値を走査するように設計されている。それによって、符合が正確に読み取られると、読み取りシステムは、制御パラメータについて一連の許容可能値を見出す。それは引き続いて、以下に詳述するように、統計的データに基づいてさらに正確化される。

【００５２】特に、読み取られる符号を担持する物体の与えられた高さに、焦点合わせ位置を最初に設定するために、読み取りシステムは、連続する獲得において、初期設定から始めてすべての可能な焦点合わせ位置の設定を試みる（例えば、自動焦点合わせデバイスが置かれている位置におけるランダムな設定）。例えば、画像獲得デバイス１０内に組込まれた光学システムの固有視野深度が周知であれば、否定的出力との各相互作用毎に、又は所定数の相互作用の後に、位置の値は固有視野深度の半分の値だけ増分される。実際は、第１の焦点合わせ値を用いて、第１の高さ（例えば１０ｃｍ）において、第１の読み取りが、デバイス１０の下を移動する第１の物体に対して又は物体の第１の組に対して試みられる、この第１の試みの出力が否定的であれば、第２の読み取り

が、第２の焦点合わせ値を用いて同じ第１の高さにおいて、第２の物体又は物体の第２の組に対して試みられる、等々。他の制御パラメータが同じようにして設定され、それらの初期値が、その焦点合わせ値を用いて、又は、一連の設定が符合読み取りを可能にする値の系列を識別するに至っていない場合には焦点合わせのための設定系列全体の完了点において同様に変更される。

【００５３】現在の設定が符合の読み取りを可能にする場合には（ブロック１５１からのＹＥＳ出力）、ブロック１５０からのＮＯ出力による制御のもとに、検討されている高さにたいする自己学習ステップが中断されて（ブロック１５２）、良好な調節ステップが開始される。それによって、物体の可能な高さの全てについて前記のプロセスが繰り返されて、初期手動設定が行われない場合でも、各パラメータの第１の近似値が高さの各々と結合される。

【００５４】自己学習ステップにおけるパラメータ値の設定に後に、動作点を検証するステップ５０は終了して、図２のブロック３０に戻り次の画像が検査される。

【００５５】他方で、検討されている動作条件の検証が完了すれば（ブロック１５０からのＮＯ出力）、その特定の動作条件において検討されているパラメータについて、十分な統計データが獲得されたかどうかが検証される（ブロック１６５）。例えば、高い画像変動性を考慮して、かつパラメータの誤った変更を回避するためには、統計的に十分であると見なされる獲得数を、５００から１０００の間に含むことが可能である。出力が否定的であれば（不十分な獲得数、ブロック１６５からのＮＯ出力）、設定は変更されず、動作点を検証するステップ５０は完了する、結果が肯定的であれば（ブロック１６５からのＹＥＳ出力）、検討されているパラメータが測定変数の夫々と、単調的関数又はより複雑な関数によって結合されているかどうかが判断される（ブロック１７０）。

【００５６】第１の場合（ブロック１７０からのＹＥＳ出力）には、現在の動作条件を考慮して、制御パラメータに結合する変数についての、図７のテーブルに記憶された統計データ（平均値）が、満足すべき作動が行われる図４のΔで表される「最適な間隔」内にあるかどうかが判断される（ブロック１７３）。記憶された平均値が最適間隔内にあれば（ブロック１７３からのＹＥＳ出力）、動作点を検証するステップ５０がいかなる変更もなしに完了する、そうでない場合には（ＮＯ出力）、制御パラメータのそれぞれが変更される（ブロック１７５）。

【００５７】好ましい、より簡潔な実施形態にしたがえば、ブロック１７０からのＹＥＳ出力に直接続いて、ブロック１７５が実施され、制御パラメータが図４の曲線を用いて安定的に変更される。

【００５８】異なるパラメータが、例示されていないやり方で、１つの測定量（従って、輝度に関わる、利得及び照明出力等の、読み取りシステムの対応する特性）に、作用を及ぼす場合には、両方のパラメータを考慮して、その変動限界から最も遠いパラメータを最初に変更する試みが可能となる。例えば、上記のパラメータについて、利得は低い値のままであるのに対して照明出力がすでに最大値に接近している場合には、初めに利得だけを増加させることが可能である。あるいは、特定の基準を適用して、どのパラメータがどれだけの量を変更されるかを決定することもまた可能である、例えば、２つのパラメータを交互に変更することが可能である。又は、１つのパラメータの変更の場合に必要とされるよりも低い値によって、両方のパラメータを同時に変更することも可能である。

【００５９】制御パラメータの新しい値が設定された後、前に記憶された統計データ及び考慮中の動作条件のための対応する獲得（サンプル）数がリセットされる、それから、制御パラメータの新しい値は作動間隔（パラメータがその範囲内で変化し得る基準間隔として定義される、ブロック１８０）内で比較される、その値がこの間隔内にあれば（ＹＥＳ出力）、動作点を変更するステップは完了し、そうでなければ（ＮＯ出力）、アラームが開始される（ブロック１８５）、なぜならば、明らかに、読み取りシステムの少なくとも１つの構成部品が（例えば、照明部品１２が消耗している等の）不満足な状態で作動を開始しようとしているからである、しかしながら、読み取りシステムは、可能な限り通常モードで作動して、新たな画像画像を獲得するために戻る。

【００６０】制御パラメータが単調的ならば、ＮＯ出力がブロック１７０から出され、図６を参照して前述したように、所定の偏差が適用される。詳述すれば、最初に、意図された所定の偏差がすでに適用されたかどうか（測定変数の平均値が、制御パラメータの偏差＋Ｊ及び－Ｊの両方について存在するかどうか、ブロック１９０）が検証される。そうでなければ、制御パラメータの値は、まだ検討されていない偏差に基づいて更新され（ブロック２００）、動作点を検証するステップは完了する。結果が肯定的であれば（ブロック１９０からのＹＥＳ出力）、統計的な記憶データが検査されて、検討されているパラメータのどの「試験済み」の値が、測定変数を最適化するかを検出する。そしてこの値は選択されて、引き続く獲得のための制御パラメータの中心値として設定される。それに対しては、前述の偏差＋Ｊ及び－Ｊが適用される（ブロック１９５）。

【００６１】続いて、単調的なパラメータの場合と同様に、統計データ及び獲得されたサンプル数が、考慮中の動作条件に対してリセットされ、実行ステップ１８０によって、パラメータの新たな中心値が意図した作動間隔内に含まれるかどうかが判断される。

【００６２】述べられたプロセスの代りとして、先行す

る調節が完了すると、所定の偏差にたいする統計データに加えて、統計データもまた、前に設定された中心値に対して、獲得され、（中心値及び意図された全ての偏差についての）全ての統計データを考慮して、引き続く設定に関連する決定が行われる。従って、前に設定された中心値が最適な所定間隔内にあれば、それは、単調なパラメータの場合と同様に、変更されない。引き続いて、全ての統計データ及び対応するサンプル数が、検討中の動作条件に対してリセットされ、そのパラメータについて動作点を検証するステップ５０が完了する。

【００６３】述べられてきた方法の長所は前述の説明から明らかである。特に、本方法は、多数の先行する画像についての統計的な資品質調査を行うことによって、設定すべき獲得パラメータを予測する、これによって、径時的な外部的及び内部的条件の変動に適応した、連続的な獲得にたいする最適化が可能となる。特に、最適な調節をモニターするためのパラメータに施される変更の経時的な解析によって、構成部品が劣化する前に状況を検出し、時宜に適った警報を発することが可能となり、故障した構成部品に起因する、読み取り装置の運転停止時間を大幅に減少させ、又は取り除くことさえも可能となる。

【００６４】成功裏に読み取られた画像（「サクセシーズ」）のみを用いることによって、統計的に意味のあるデータを用いることが保証され、そして特定の条件から引き出されたデータ又は確率誤差に影響されたデータが排除され、そのために制御されるべきパラメータの不適切な又は不正確な変更を抑制することが可能となる。さらに、読み取られた符号の最重要部分のみを用いることによって、本方法の信頼性及びパラメータの最適値への収束性が増大する。

【００６５】それぞれの測定量を伴う複雑な関数と結合したパラメータの場合において、小さな変更を現在値に導入することにより最適なパラメータを検索することによって、これらの複雑な関数が予め知られていない場合でも、「試行錯誤」のプロセスによって、最適な動作条件を取得しかつ維持することが可能になる。

【００６６】最後に、ここで説明され例示された方法に対して、多くの修正及び変更を施すことが可能であり、それらの全ては、添付クレームにおいて定義されるように、本発明の範囲内にあることは、明らかである。特に、上述の方法は、焦点合わせの特品質及び画像の輝度にたいする最適化を可能にするのみでなく、他のパラメータにも適用可能であるということが、強調される。例えば、符合要素間の寸法的関係が基準値から受け入れがたくかけ離れているかどうか、又は不正確な変更に従っているかどうかを検証する場合に、本方法は、デコーディングに用いられる閾値を適合させるために用いることができる。それはまた、物体の走査速度の値を補正するために用いることができる。外部的に与えられたその初期設定は、光エンコーダ５によって検出された実際の速度と異なるコンベヤベルト２の推定進行速度に基づいているために、又は機械的搬送システムにおける経時的な変化のためにもはや機能的に十分でない（そのため、歪んだ画像の獲得を引き起こす）ために、正しくない可能性がある。

【００６７】しかしながら一般に、本方法は、獲得された画像が互いに大きく異なっている場合に適用することができる。そのため、いくつかの基本的なパラメータが画像の獲得頻度に比べて相対的に遅いゆらぎを受ける場合、及び、数学的計算を通して又はセンサーのみを用いて、パラメータのゆらぎを推定することが可能ではない又は好都合でない場合、にパラメータの予測的な調節が行われる必要がある。

【００６８】

【発明の効果】以上説明したように本発明によれば、光符号読み取りシステムにおいて、連続する画像の諸特性の変化速度が高い場合に特に適合する、特性変数の自動的な調節方法を提供できるものである。

【図面の簡単な説明】

【図１】光符合読み取りシステムを示す図。

【図２】本発明に係る方法の動作を示す流れ図。

【図３】図２のブロックの詳細な動作を示す流れ図。

【図４】夫々の制御量を伴う図１におけるシステムにおいて制御されるいくつかのパラメータに関連する関数を示す図。

【図５】夫々の制御量を伴う図１におけるシステムにおいて制御されるいくつかのパラメータに関連する関数を示す図。

【図６】夫々の制御量を伴う図１におけるシステムにおいて制御されるいくつかのパラメータに関連する関数を示す図。

【図７】本発明の方法に有効なテーブルを示す図。

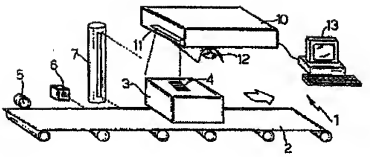
【図８】本発明の方法に有効なテーブルを示す図。

【図９】図２の別のブロックの詳細な流れを示す図。

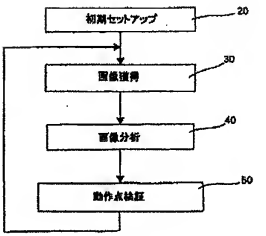
【符号の説明】

１…光符号読み取り装置、２…コンベヤベルト、３…物体、４…光符号、５…光エンコーダ、６…存在センサー、７…高さセンサー、１０…画像獲得デバイス、１１…感知領域、１２…照明部品、１３…処理ユニット。

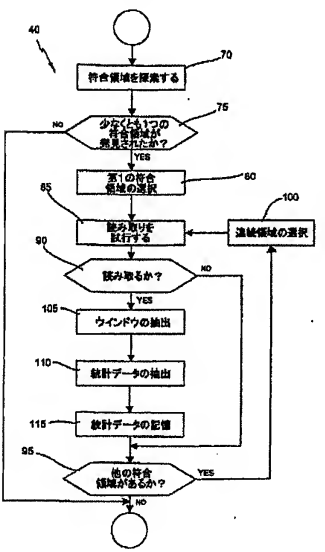
【図１】



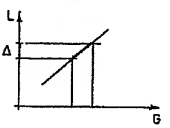
【図２】



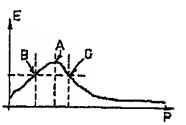
【図３】



【図４】



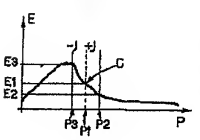
【図５】



【図８】

H(cm)	N(−J)	E(−J)	N(+J)	E(+J)
0	N1	E1	N6	E6
10	N2	E2	N7	E7
20	N3	E3	N8	E8
30	N4	E4	N9	E9
40	N5	E5	N10	E10

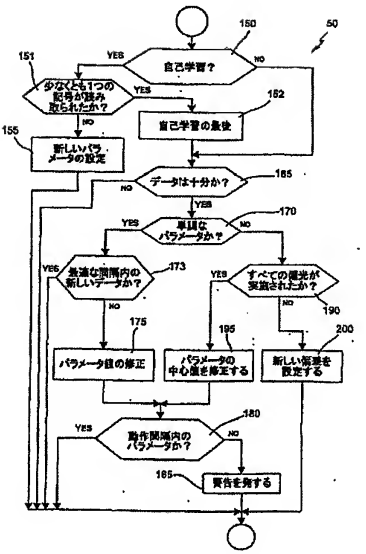
【図６】



【図７】

H(cm)	N	L
0	N1	V1
10	N2	V2
20	N3	V3
30	N4	V4
40	N5	V5

【図９】


150
50
151
YES
自己学習？
NO
少なくとも1つの記号が読み取られたか？
YES
152
自己学習の最後
155
NO
新しいパラメータの設定
データは十分か？
185
NO
YES
170
YES
重要なパラメータか？
NO
YES
173
最適な領域内の新しいデータか？
YES
すべての優光が実施されたか？
NO
190
NO
175
195
200
パラメータ組の修正
パラメータの中心値を修正する
新しい係数を設定する
180
YES
動作領域内のパラメータか？
NO
185
警告を発する

Machine Translation

Japanese Patent – 2000-231600

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which an invention belongs] This invention relates to the method of adjusting the characteristic of an optical code reading system automatically.

[0002]

[Description of the Prior Art]In the following, the term of an "optical code" is used, when it means the graphic display which has the function to memorize the coded data. Although a linear code or two-dimensional numerals are contained in the specific example of an optical code, Data In this case, a bar code and stack-ized numerals (PDF417 is included), Maxi code (Maxicode), the data matrix (Datamatrix), It is coded by what combined appropriately the element with the predetermined shape, for example, the square, rectangle, or hexagon of the dark color (it is usually black) separated by bright elements (usually white space), such as QR numerals and color numerals.

[0003]The term of an "optical code" further more generally contains non-coding characters (a character, a number, etc.) and specific patterns (a stamp, a logo, a signature, etc.). These information may be coded again, three or more colors, for example, a gray color tone.

[0004]Numerals are for an optical code to exist.

It is possible to read by acquiring a two-dimensional picture in the field that localizing the numerals within a picture is expected.

[0005]The step which generally distinguishes first one or more fields where at least one numerals exist within the picture memorized immediately before for numerals localization, Next, the step of one ream which comprises the step which localizes a specific recognition pattern to each numerals, the step which gains the data about a actual numerals type, and the step which divides numerals into the last correctly is required. By next, this divided numerals picture is processed in order to extract the feature required for decoding, and eventually, in order to extract required data, decoding of these numerals is carried out.

[0006]Although it can say that data was extracted, and especially decoding operation has been recognized to be exact, was begun, and was completed correctly, On the contrary, when a processing system succeeds in no extraction of data, when the probability that the extracted data is exact is insufficient, or when the extracted data is not equivalent to the data needed, it means completing it in the negative.

[0007]Although it depends on some factors for the probability that reading will be successful, some things of them are the problems (for example, quality etc. of the optical code read) of the exterior of a reading system.

Other things are based on the photoelectricity/mechanical parameter of a reading system.

[0008]In fact, it has the variable characteristic about the type and time of installation with each inspected thing like other physical systems with any reading systems. Especially the characteristic of a reading system changes with each component parts which constitute the inspected thing which has the characteristic of changing within specific common difference (breadth). In addition, the external conditions (for example, temperature) take many component parts for changing, and the characteristic changes and carries out degradation with the passage of time.
[0009]although the calibration method used among the both sides of manufacture and installation is common knowledge in order to solve these problems -- it -- in addition, while operator control is carried out automatically and the system of relation is operating, a regulating method with an effect is common knowledge.
[0010]In the optical code reading system which reads the object which is carrying out unintercepted movement, although it is difficult especially to adjust the characteristic, this is because it is impossible to concentrate on a reference image and the characteristic of a picture gained very promptly.
[0011]If drawing 1 is referred to in order to understand the existing problem better, the place indicating the object 3 in which the conveyor belt 2 with which the common optical code reader named generically with the reference number 1 is provided is supporting the optical code 4 which is a bar code in this case is shown.
[0012]The conveyor belt 2 is combined with the optical encoder 5, and the speed of the object 3 is measured, in addition the existence sensor 6 and the height sensor 7 are put on one conveyor-belt 2 side.
[0013]Above the conveyor belt 2, the picture acquisition device 10 which has the sensing area 11 and is pointing to the lighting part 12 is arranged.
The picture acquisition device 10 is connected to the handling unit 13 which can also be included in the picture acquisition device 10 as an option again and which is expressed with the personal computer in this case.

[0014]In order for the system of the type shown in drawing 1 to operate correctly, it is indispensable to set correctly many parameters of the picture acquisition device 10 of the lighting part 12 and the handling unit 13. In particular, in an optical code reading system, although there are picture focusing and luminosity in the indispensable characteristic, there is fixed modification of the dimension on the appearance of the object which is caused by printing and/or the far and near phenomenon, for example, is read, and an optical code in other important characteristics. These characteristics can be detected by measuring physical quantity of a certain kind directly. For example, although focusing of a picture is detectable by measuring the energy of the analog signal supplied from the picture acquisition device 10, or a digital signal, it is because luminosity inclination is low, therefore the energy of the picture which faded is also low so

that **** [the reason].
[0015]It depends for the various characteristics of a reading system, therefore a corresponding measurand on the value of two or more parameters of a reading system. For example, the following are important in the parameter which can be adjusted. The position of an automatic-focusing doubling device, the sensitivity (.) of the picture acquisition device 10 Namely, the profit of the circuit in the device 10 which acquires the electrical signal produced in the sensing area 11, and performs initial processing, the scan speed of the object which is emitted by the illuminating devices 11 and which is outputted and (namely, service voltage which is given to the lighting part 12, and which is carried out) investigated (although set up externally) It is a threshold required for the decoding processing which is dependent on the movement speed of the conveyor belt 2, and judges whether a specific voltage level corresponds to "white" or "black", for example.
[0016]It depends for some optimum values of these parameters (a metaphor is the irradiation output and sensitivity of the position of an automatic-focusing doubling device, and a television camera) on the height of the object to the picture acquisition device 10.
[0017](For example, like [of the shot of television]) In the reading system by which the pictures acquired differ little by little mutually, the problem which optimizes these parameters is already solved by various methods. [one] [after another] For example, the television camera for televisions of all the marketing has an automatic gain control function, and it is possible to suit various lighting conditions. It becomes possible to fit oneself of a television camera to the sensitivity for acquiring the following picture considered not to differ from the picture greatly by analyzing the acquired newest picture. Similarly, all the commercial television cameras have an automatic-focusing doubling device which analyzes the newest obtained image (based for example, on color convergence).
[0018]Actually, feedback mechanism is used in order to acquire the best imaging quality promptly.
[0019]
[Problem(s) to be Solved by the Invention]However, when the picture acquired succeeding the case where the variation speed of a picture characteristic becomes large too much, and it becomes impossible to compare with acquisition speed may completely be mutually different, above-mentioned feedback mechanism does not function any longer. In such a case, it is required for the characteristic of the following picture to predict to appear in a television camera, and to optimize all the acquisition parameters beforehand.
[0020]For example, although predicting capability can be heightened by using the additional sensor which supplies beforehand the data about the distance between an object and a television camera, or its average luminance, this method is not enough in many cases.
[0021]For example, change of the lighting resulting from degradation of a lamp with the passage of time cannot be measured depending on only calculating the average measurement luminance value of the object which should be gained (for

the reason, it cannot amend again). When a dark object continues extremely long, a lighting unit may be suddenly judged to have carried out degradation with the passage of time.
[0022]Similarly, the optimal focusing position may be changed in time influenced by the electromechanical various characteristics of fluctuation of an automatic-focusing doubling positioning device or distance sensors.
[0023]The purpose of this invention is to provide the automatic regulating method of the characteristic variable which suits especially when the variation speed of the various characteristics of a continuous picture is high in an optical code reading system.
[0024]
[Means for Solving the Problem]If this invention is followed, a method for adjusting automatically at least one characteristic variable of an optical agreement reading system characterized at the following steps is provided.
[0025]acquisition of a step a picture, and Step b -- at least one optical agreement in the picture is read, [try and] Step c -- verification of whether the reading was completed correctly, and Step d -- acquisition of the characteristic variable about the picture when that is right, and Step e -- change of at least one controlled parameter which acts on change of the acquired characteristic variable.
[0026]A characteristic variable (or quantity) is acquired suitably several times, an average statistical data is acquired about reading of a large number, and a real qualitative difference between continuous pictures is measured. Regulation is performed continuously and change of the characteristic of a reading system resulting from change of component parts of an environmental cause or an inside is monitored.
[0027]Display brightness and the focusing characteristic are contained in quantity of the characteristic adjusted, and a control parameter is chosen as it from a focusing position, picture acquisition sensitivity, a lighting output, a judgment threshold used for reading, and image scanning speed.
[0028]A control parameter, respectively and when a relation between each of the amount of characteristics is not known, This method changes a value of the present parameter with one positive small displacement and one negative small displacement at least from the current value, and assesses which [of the two displacement] gives better imaging quality. In continuing reading to lengthen, a value with a new control parameter turns into a center value. By repeating this process, it becomes easy to move a center value of a control parameter toward optimal position promptly, and it can monitor any change of-like at the time of a path of this position.
[0029]The further characteristic of this invention will become clear by explanation of a desirable embodiment which is given as completely un-restrictive illustration, and is described with reference to the following accompanying drawings.
[0030]
[Embodiment of the Invention]By this invention, if it is possible only for the initial learning time (it is not assumed that the reading system is operating correctly in the meantime) when a reading system is specific to stand by, It becomes

possible using an initial self-learning process to initialize the parameter of an optical agreement reading system, It becomes possible to change continuously the present regulation for fitting parameter value to the-like change at the time of the surrounding environment and the path of internal component parts further again using the optimized method (autogenous control).
[0031]In the embodiment of drawing 2 which follows this invention especially, there is an alternative step of initial setting of a parameter first (block 20). This step is manual, once a reading system is attached, it is carried out (or after maintenance discontinuation of component-parts exchange), but it can abbreviate to having already stated.
[0032]Then, the block 30 with which a picture including the optical agreement which should be inspected is acquired. in a reading process -- this article -- for the autogenous control at the time of a standard operation also for self-study in case a reading system carries out the operation start of this qualitative picture acquisition -- this article -- it is qualitative. It is peculiar to all the optical agreement reading systems, and picture acquisition is performed in accordance with the well-known method using CCD or CMOS type linearity or a matrix sensor, and supplies the analog or the digital electrical signal relevant to a luminance level of each dot (pixel) which forms a picture.
[0033]Then, the block 40 with which the acquired picture is analyzed. this analysis described below with reference to drawing 3 is unnecessary to regulation of a control parameter, when the purpose of trying the purpose of searching the present optical agreement (two or more optical agreements), decoding, or recognition, and a positive consequence come out in a picture -- it has the purpose which gains the image volume of shoes and is memorized appropriately.
[0034]The block 50 whose monitor of dynamic change of a reading system it is finally judged whether it is necessary to change the operating point of a reading (given by 1 set of present value of control parameter) system, and the initial self-study of is attained, or is attained. Although an operating point change step is explained below with reference to drawing 4 thru/or drawing 9, following on it, it returns to the block 20 and acquisition of a new picture is performed.
[0035]The step (block 40 of drawing 2) which analyzes the acquired picture is explained with reference to drawing 3. The block 70 which will search first the field which probably includes optical agreement within the picture which the handling unit 13 was gained and was memorized if it explains in full detail. This step is performed using the method of the common knowledge which searches for the field which has the biggest contrast within a picture, for example. Agreement is formed of an element or structure with a different color (for example, white and black), and it is because the specific repetitive shift of the color is the purpose of coding.
[0036]. Then, a reading system verifies whether at least one agreement field was identified. The block 75, the block 85 which ends the analysis step 40 if not verified (NO output) and with which the 1st discernment agreement field (or only) will be chosen (block 80), and reading will be tried if verified (YES output). If the

numerals which are performed by the well-known method according to the type of the numerals read and which are read especially contain the character, the trial of reading reading, If the bar code or the two-dimensional code performed based on the character recognition in a fully reliable method is contained, reading comprises coding of agreement by a method exact enough. For example, if the method usually used is followed in the case of a bar code, the existence of the element (bar) of a series of colors which carry out a repetitive shift will be verified, It is verified whether the number of elements becomes equal to one predetermined value after all, and the width of each element is measured, The width or conditions predetermined [at least] in those some (for example, whether they are related mutually.) or it has the given order -- **** -- it is verified selectively whether it fills or not, the series of the number corresponding to the repetitive shift of the detected element is determined, and it is judged whether it is the agreement whose conditions an obtained number of series suit.

[0037]Then, the block 90 with which it is verified whether reading was completed on the success reverse side. This step is dramatically important. It is because it is shown that the positive consequence of agreement reading has quality sufficient in order that the field currently examined may acquire the present value of a measurand (the statistical data used in order that it may adjust the value of a parameter will be specified if this invention is followed). the statistical data in which the field which is used in order that only the imaging range which guarantees good reading of optical agreement may change the value of a parameter, and which reading can be impossible or cannot fully be trusted on the other hand was actually obtained when following this invention -- the right -- things -- since it cannot guarantee, these fields are refused. As a result, if reading does not take place (NO output from the block 90) and there are no block 95 and other fields where it is verified how [from which other agreement fields were not detected in the searching step 70 of the same picture] it is, . NO output is taken out from the block 95 and end the image-analysis step 40. Otherwise, (the YES output from the block 95 where other fields exist and which has the possibility of the existence of optical agreement in the same picture there), and the continuing agreement field are chosen, the block 100 and reading are tried, and it returns to the block 35.

[0038]If reading is successful (YES output from the block 90), one copy of the agreement field identified before will be chosen, namely, it will specifically consider that the field is best about quality. The center portion of the optical agreement by which decoding is carried out especially is chosen suitably, and an edge effect is removed (block 105 of window extraction).

[0039]Then, the block 110 with which the exactly selected window is processed and the value of statistical data, i.e., a measurand, is gained. In particular, all the measurands are measured and calculated in this step. all the indices of the modification of all the deviations from the predetermined value of a maximum brightness value (namely, white level in 2 color agreement measured as a gray level), a minimum luminance value (black level), an average level, signal average energy, and the rate of an agreement element and agreement shape to it -- ** is

contained. On the luminosity scale especially contained between 0 and a 255 binary level, on relevant luminosity conditions, a white level is a binary value near 200, and a black level is [ten] near. Signal energy is calculable as square [of the amplitude of the differential coefficient of a luminance signal].
[0040]The block 115 with which every one statistical data calculated exactly is memorized on a suitable table about each variable. This statistical data is independently memorized suitably according to the distance (obtained from the height of the object in which that picture was detected) between an inspected object and the picture acquisition device 10. Because, it is preferred to memorize the number of the samples which are because the optimum value of a parameter is decided by this distance and from which these tables had been gained further so far, total value, and the average value calculated by dividing total value by a sample number. In practice, for every new acquisition, about each of the measured value, according to the value of the present height of an inspected object, one sample number is increased at a time, total value is updated, the newly gained value is applied to the pre- total, and average value is updated.
[0041]The table of two different types is constituted depending on the measurement variable examined, the parameter combined with it, and the characteristic optimized, and the details are explained below with reference to drawing 7 and 8.
[0042]If it is verified whether the further agreement field exists in a picture as already stated in relation to the block 95 and it does not exist after a statistical data table is updated (block 115), the image-analysis step 40 is ended.
[0043]Before explaining Step 50 for verifying the operating point in full detail, in order to optimize the characteristic of the method **** reading system of this invention, the mechanism for adjusting a parameter based on the gained statistical data is explained. Some characteristics (display brightness measured by the maximum and the minimum luminance value) actually, It has monotonous (it can know approximately correctly or at least) correlation to each of a control parameter (the amplitude profit of a picture acquisition device, and the output of the lighting part 12), for example, it is shown in drawing 4 showing the relation between the luminosity L and the profit G. Therefore, if based on a measurement variable value (the minimum and maximum brightness value) in this case, in order to optimize reading, it is easy to identify the amendment performed to the parameter value controlled. For example, after the predetermined number of acquisition, if all the agreement fields gained about specific height are dark colors (a predetermined value, for example, the maximum digitization luminance value lower than 180), it is required to increase a profit and/or to increase a lighting output (for example, voltage supplied to the lighting part 12).
[0044]Other characteristics like the focusing capability measured by the energy of the electrical signal supplied by the picture acquisition device 10 in another side, It has more complicated correlation to each of a control parameter, and it is shown by drawing 5 showing the function which connects the position P to average energy E of for example, an automatic-focusing doubling device. In this case, in order to optimize reading, it is impossible to use directly the specific

principle which connects a measurement variable and a control parameter (approximately [even if]). In the case of the function of the type in which a curve has absolute maximum and which is shown in drawing 5, the following problems actually exist.

[0045]As for the absolute value of the maximum A, the operating point which cannot judge whether the picture which was changed to the picture and was exactly acquired from the picture for the reason is best is left-hand side or on the right-hand side of (in drawing 5) the maximum. It is impossible to judge whether it is located in the point B or the point C of having the same ordinate, therefore in order to improve reading, it is impossible to determine in which direction a focusing position must be changed.

[0046]Therefore, in the case of the measurand combined with each of the control parameter in non-line type. By performing acquisition of a specified number accompanied by a change of the same desirable value positive and negative which made the value of the control parameter change slightly about the method of this invention, therefore the present setting out, While discernment of the bending point when the reading system was placed is attained, an alternative determination of the direction of the actual amendment of whether amendment is required judged and performed is attained. For example, if the system is located in the point C corresponding to the position P1 and the average energy E1 to acquisition of a specified number with reference to drawing 6 similar to drawing 5, Only displacement +J is changed first, the value of a position shifts to the position P2, and the average energy value E2 is obtained after acquisition of a specified number in this way, and an initial value is displaced. - Only J is changed, it shifts to the position P3, and the average energy value E3 is obtained in this way. In this case, since the optimal read condition corresponds to the maximum energy level, clearly, a result best in the 2nd setting out (- J) is given, and the center value of a control parameter must be become final and conclusive by P3 in this way.

[0047]Especially the absolute value of the displacement J must be large enough so that change of imaging quality may be discerned, however it must be small enough so that reading of optical agreement may not be barred. This displacement is suitably chosen within the interval between the minimum which makes possible verification of a characteristic variable and reading of optical agreement which were detected, and the maximum. It is because the direction of the displacement for autogenous control measurement taking place at the time of the normal system operation of a reading system, and optimizing operation is not identified, so it reads also about the displacement which is separating and moving from the optimal conditions and the function of a system must be maintained.

[0048]A change of a control parameter based on predetermined displacement is made for every acquisition of every acquisition or a predetermined number.

[0049]And in the case of the measurement variable and control parameter in monotonous correlation, in the data storage step 115, the table of the type of drawing 7 is used suitably. In the case of the measurement variable and control

parameter in another side and un-monotonous correlation the sequence of total value is not indicated to be for simplification, the table of the type of drawing 8 is used there. There, sample number N (-J), N (+J) and calculated average energy E (-J), and E (+J) are shown about each of the value of objective height, and both displacement +J and -J.

[0050]The operating point is verified based on above-mentioned explanation, and the step (block 50 of drawing 2) changed selectively is explained with reference to drawing 9 about a single control parameter. However, Step 50 is repeated after each image-analysis step 40 about each of the control parameter of a reading system.

[0051]******** [that first a reading system is in the state of self-study in the block 150] (for the operating condition which should be examined, including the present distance between an inspected object and the picture acquisition device 10) It is verified whether initial setting which reads possible has not been found out yet, or it is in the state of good regulation. In the case of the 1st (YES output from the block 150), on the present operating condition, it is verified whether at least one proper agreement reading was performed (block 151). Otherwise, (NO output from the block 151) and a control parameter are set as the value which has not been used yet (block 150). The step of ****** food ****** between the self-learning steps to each acquired image which has not resulted by decoding of optical agreement, According to the predetermined scheme, it is designed scan all the values in which a control parameter is possible until setting out which makes agreement reading possible is found out in a specific operating condition. If agreement is correctly read by it, by it, a reading system will find out a series of permissible values about a control parameter. Succeedingly, it is further made exact based on statistical data so that it may explain in full detail below.

[0052]In order to set a focusing position as the height to which the object which supports the numerals read especially was given first, a reading system, In continuous acquisition, setting out of all the possible focusing positions is tried starting with initial setting (for example, random setting out in the position on which the automatic-focusing doubling device is put). For example, if the peculiar view depth of the optical system incorporated in the picture acquisition device 10 is common knowledge, the increment of the value of a position will be carried out only the value of the half of peculiar view depth every interaction with a negative output, or after the interaction of a predetermined number. In practice, in the 1st height (for example, 10 cm) using the 1st focusing value, If the output of this 1st trial by which reading of the 1st is tried to the 1st objective group as opposed to the 1st object that moves in the bottom of the device 10 is negative, ** -- in the 1st same height, reading of the 2nd is tried to the 2nd group of the 2nd object or an object using the 2nd focusing value. Other control parameters are set up similarly, and in the completing point of the whole setting-out series for focusing, those initial values are similarly changed, when a series of setting out has not come to identify the series of the value which makes agreement reading possible, using the focusing value.

[0053]When the present setting out makes reading of agreement possible, the

self-learning step to the height currently examined is interrupted by the basis of control by (the YES output from the block 151), and NO output from the block 150 (block 152), and a good regulation step is started. Even when the aforementioned process is repeated about all the objective possible height by it and initial manual setting is not performed, the 1st approximate value of each parameter is combined with each of height.

[0054]Step 50 which verifies the operating point behind to setting out of the parameter value in a self-learning step is ended, it returns to the block 30 of drawing 2, and the following picture is inspected.

[0055]If verification of the operating condition currently examined is completed on the other hand (NO output from the block 150), it will be verified whether enough statistical datas were gained about the parameter currently examined on the specific operating condition (block 165). For example, in order to avoid change which the parameter mistook in consideration of high image change nature, it is possible for the number of acquisition consider that is enough statistically to be included from 500 to 1000. If the output is negative (the insufficient number of acquisition, NO output from the block 165), If the result which completes Step 50 which setting out is not changed but verifies the operating point is affirmative (YES output from the block 165), it will be judged whether the parameter currently examined is combined by each, and the monotonous function or the more complicated function of the measurement variable (block 170).

[0056]In the case of the 1st (YES output from the block 170), It is judged whether in consideration of the present operating condition, the statistical data (average value) memorized on the table of drawing 7 about the variable combined with a control parameter is in "the optimal interval" expressed with delta of drawing 4 to which the operation which should be satisfied is performed (block 173). If the memorized average value is in the optimal interval (YES output from the block 173), when [which is not so] Step 50 which verifies the operating point completes any change nothing, each of (NO output) and a control parameter will be changed (block 175).

[0057]If a desirable briefer embodiment is followed, direct, then the block 175 will be carried out from the block 170 to a YES output, and a control parameter will be stably changed using the curve of drawing 4.

[0058]When a different parameter exerts an operation on one measurand (therefore, characteristic that reading systems, such as a profit, a lighting output, etc. in connection with luminosity, correspond), in the way which is not illustrated, In consideration of both parameters, the trial which changes the furthest parameter from the fluctuation limit first becomes possible. For example, about the above-mentioned parameter, as for a profit, when the lighting output has already approached the maximum to being still a low value, it is possible to make only a profit increase first. Or it is also possible to apply a specific standard and to determine the quantity of which which parameter has changed, for example, it is possible to change two parameters by turns. Or it is also more possible to change both parameters simultaneously with a low value than being needed in change of one parameter.

[0059]. After a value with a new control parameter is set up, the number of acquisition (sample) to which it corresponds for the statistical data memorized before and an operating condition under consideration is reset. And the value with a new control parameter is an operation interval (a parameter is defined as a reference interval which may change within the limits of it, and). it completing, otherwise, (NO output) and alarm being started (block 185), because the step which changes the operating point, if that value compared within the block 180 is in this interval (YES output), it is because at least one component parts of a reading system are going to start the operation in the dissatisfied state (for example, the lighting part 12 is exhausted) clearly -- however, The reading system operates by the normal mode as much as possible, and it returns in order to acquire a new picture picture.
[0060]If it is monotonous-like [a control parameter], NO output will be taken out from the block 170, and a predetermined deviation will be applied as mentioned above with reference to drawing 6. If it explains in full detail, it will be verified whether the meant predetermined deviation was already applied first (it is [whether the average value of a measurement variable exists about both deviation +J of a control parameter, and -J, and] the block 190). Otherwise, the value of a control parameter is updated based on the deviation which has not been examined yet (block 200), and the step which verifies the operating point is completed. If the result is affirmative (YES output from the block 190), "the examined value" of the parameter throat which statistical stored data is inspected and is examined will detect whether a measurement variable is optimized. And this value is chosen and is set up as a center value of the control parameter for the continuing acquisition. To it, above-mentioned deviation +J and -J are applied (block 195).
[0061]Then, like the case of a monotone parameter, a statistical data and the gained sample number are reset to an operating condition under consideration, and it is judged whether it is contained in the operation interval which the new center value of the parameter meant with the execution step 180.
[0062]As opposed to the center value with which the statistical data was also before set up in addition to the statistical data to a predetermined deviation when the regulation to precede was completed as a substitute of the described process, It is gained and a decision relevant to continuing setting out is made in consideration of all (about a center value and all the meant deviations) the statistical data. Therefore, if the center value set up before is in the optimal prescribed interval, it will not be changed like the case of a monotone parameter. Then, all the statistical datas and corresponding sample numbers are reset to the operating condition under examination, and Step 50 which verifies the operating point about the parameter is completed.
[0063]The strong point of the described method is clear from the above-mentioned explanation. The optimization especially of this method to the continuous acquisition of-like at the time of a path which was external and was adapted for change of internal conditions is attained by this which predicts the acquisition parameter which should be set by performing statistical **********

about the picture which a large number precede. In the temporal analysis of change performed to the parameter for monitoring the optimal regulation especially. It becomes possible to decrease substantially the shutdown time of a reader which detects a situation before component parts deteriorate, and it becomes possible to emit the alarm which suited the right time, and originates in broken component parts, or to even remove it.
[0064]By using only the picture ("SAKUSE seeds") read by the success reverse side, It becomes possible to control an unsuitable or inaccurate change of the parameter which the data influenced by the data or probable error which using the data which is statistically meaningful was guaranteed, and was pulled out from specific conditions should be eliminated, therefore should be controlled. The reliability of this method and the convergency to the optimum value of a parameter increase by using only the primary importance portion of the read numerals.
[0065]In the case of the parameter combined with the complicated function accompanied by each measurand, Even when these complicated functions are not beforehand known by searching the optimal parameter by introducing a minor change into a present value, it becomes possible to acquire and maintain the optimal operating condition by the process of "trial and error."
[0066]It is possible to perform many corrections and change finally to the method which was explained here and illustrated, and those all of be [it / within the limits of this invention] are clear so that an attachment claim may be defined. It is emphasized that especially an above-mentioned method not only enables the optimization to ****** of focusing and the luminosity of a picture, but it is applicable to other parameters. For example, when verifying whether whether it being hard to accept the dimensional relation between agreement elements, and it being widely different from the reference value and an inaccurate change are followed, this method can be used in order to fit the threshold used for decoding. It can be used in order to amend the value of an objective scan speed. Since the initial setting given externally is due to the presumed speed of advance of the different conveyor belt 2 from a actual speed detected by the optical encoder 5, Or because of the temporal change in a mechanical carrier system, since it is not functionally enough any longer (therefore, acquisition of the perverted picture is caused), it may not be right.
[0067]However, generally, this method can be applied, when the acquired pictures differ greatly mutually. Therefore, when some fundamental parameters receive late fluctuation relatively compared with the acquisition frequency of a picture, And prediction regulation of a parameter needs to be performed, without the case that it is not possible to presume fluctuation of a parameter only using a sensor through a mathematical calculation, or where it is not convenient.
[0068]
[Effect of the Invention]As explained above, according to this invention, in an optical code reading system, the automatic regulating method of the characteristic variable which suits especially when the variation speed of the various characteristics of a continuous picture is high can be provided.

TECHNICAL FIELD

[The technical field to which an invention belongs] This invention relates to the method of adjusting the characteristic of an optical code reading system automatically.

PRIOR ART

[Description of the Prior Art]In the following, the term of an "optical code" is used, when it means the graphic display which has the function to memorize the coded data. Although a linear code or two-dimensional numerals are contained in the specific example of an optical code, Data In this case, a bar code and stack-ized numerals (PDF417 is included), Maxi code (Maxicode), the data matrix (Datamatrix), It is coded by what combined appropriately the element with the predetermined shape, for example, the square, rectangle, or hexagon of the dark color (it is usually black) separated by bright elements (usually white space), such as QR numerals and color numerals.

[0003]The term of an "optical code" further more generally contains non-coding characters (a character, a number, etc.) and specific patterns (a stamp, a logo, a signature, etc.). These information may be coded again, three or more colors, for example, a gray color tone.

[0004]Numerals are for an optical code to exist.

It is possible to read by acquiring a two-dimensional picture in the field that localizing the numerals within a picture is expected.

[0005]The step which generally distinguishes first one or more fields where at least one numerals exist within the picture memorized immediately before for numerals localization, Next, the step of one ream which comprises the step which localizes a specific recognition pattern to each numerals, the step which gains the data about a actual numerals type, and the step which divides numerals into the last correctly is required. By next, this divided numerals picture is processed in order to extract the feature required for decoding, and eventually, in order to extract required data, decoding of these numerals is carried out.

[0006]Although it can say that data was extracted, and especially decoding operation has been recognized to be exact, was begun, and was completed correctly, On the contrary, when a processing system succeeds in no extraction of data, when the probability that the extracted data is exact is insufficient, or when the extracted data is not equivalent to the data needed, it means completing it in the negative.

[0007]Although it depends on some factors for the probability that reading will be successful, some things of them are the problems (for example, quality etc. of the optical code read) of the exterior of a reading system.

Other things are based on the photoelectricity/mechanical parameter of a reading system.

[0008]In fact, it has the variable characteristic about the type and time of installation with each inspected thing like other physical systems with any reading systems. Especially the characteristic of a reading system changes with each component parts which constitute the inspected thing which has the characteristic of changing within specific common difference (breadth). In addition, the external conditions (for example, temperature) take many component parts for changing, and the characteristic changes and carries out degradation with the passage of time.
[0009]although the calibration method used among the both sides of manufacture and installation is common knowledge in order to solve these problems -- it -- in addition, while operator control is carried out automatically and the system of relation is operating, a regulating method with an effect is common knowledge.
[0010]In the optical code reading system which reads the object which is carrying out unintercepted movement, although it is difficult especially to adjust the characteristic, this is because it is impossible to concentrate on a reference image and the characteristic of a picture gained very promptly.
[0011]If drawing 1 is referred to in order to understand the existing problem better, the place indicating the object 3 in which the conveyor belt 2 with which the common optical code reader named generically with the reference number 1 is provided is supporting the optical code 4 which is a bar code in this case is shown.
[0012]The conveyor belt 2 is combined with the optical encoder 5, and the speed of the object 3 is measured, in addition the existence sensor 6 and the height sensor 7 are put on one conveyor-belt 2 side.
[0013]Above the conveyor belt 2, the picture acquisition device 10 which has the sensing area 11 and is pointing to the lighting part 12 is arranged.
The picture acquisition device 10 is connected to the handling unit 13 which can also be included in the picture acquisition device 10 as an option again and which is expressed with the personal computer in this case.

[0014]In order for the system of the type shown in drawing 1 to operate correctly, it is indispensable to set correctly many parameters of the picture acquisition device 10 of the lighting part 12 and the handling unit 13. In particular, in an optical code reading system, although there are picture focusing and luminosity in the indispensable characteristic, there is fixed modification of the dimension on the appearance of the object which is caused by printing and/or the far and near phenomenon, for example, is read, and an optical code in other important characteristics. These characteristics can be detected by measuring physical quantity of a certain kind directly. For example, although focusing of a picture is detectable by measuring the energy of the analog signal supplied from the picture acquisition device 10, or a digital signal, it is because luminosity inclination is low, therefore the energy of the picture which faded is also low so that **** [the reason].
[0015]It depends for the various characteristics of a reading system, therefore a corresponding measurand on the value of two or more parameters of a reading

system. For example, the following are important in the parameter which can be adjusted. The position of an automatic-focusing doubling device, the sensitivity (.) of the picture acquisition device 10 Namely, the profit of the circuit in the device 10 which acquires the electrical signal produced in the sensing area 11, and performs initial processing, the scan speed of the object which is emitted by the illuminating devices 11 and which is outputted and (namely, service voltage which is given to the lighting part 12, and which is carried out) investigated (although set up externally) It is a threshold required for the decoding processing which is dependent on the movement speed of the conveyor belt 2, and judges whether a specific voltage level corresponds to "white" or "black", for example.
[0016]It depends for some optimum values of these parameters (a metaphor is the irradiation output and sensitivity of the position of an automatic-focusing doubling device, and a television camera) on the height of the object to the picture acquisition device 10.
[0017](For example, like [of the shot of television]) In the reading system by which the pictures acquired differ little by little mutually, the problem which optimizes these parameters is already solved by various methods. [one] [after another] For example, the television camera for televisions of all the marketing has an automatic gain control function, and it is possible to suit various lighting conditions. It becomes possible to fit oneself of a television camera to the sensitivity for acquiring the following picture considered not to differ from the picture greatly by analyzing the acquired newest picture. Similarly, all the commercial television cameras have an automatic-focusing doubling device which analyzes the newest obtained image (based for example, on color convergence).
[0018]Actually, feedback mechanism is used in order to acquire the best imaging quality promptly.

EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, according to this invention, in an optical code reading system, the automatic regulating method of the characteristic variable which suits especially when the variation speed of the various characteristics of a continuous picture is high can be provided.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, when the picture acquired succeeding the case where the variation speed of a picture characteristic becomes large too much, and it becomes impossible to compare with acquisition speed may completely be mutually different, above-mentioned feedback mechanism does not function any longer. In such a case, it is required for the characteristic of the following picture to predict to appear in a television camera, and to optimize all the acquisition parameters beforehand.
[0020]For example, although predicting capability can be heightened by using the additional sensor which supplies beforehand the data about the distance between an object and a television camera, or its average luminance, this

method is not enough in many cases.
[0021]For example, change of the lighting resulting from degradation of a lamp with the passage of time cannot be measured depending on only calculating the average measurement luminance value of the object which should be gained (for the reason, it cannot amend again). When a dark object continues extremely long, a lighting unit may be suddenly judged to have carried out degradation with the passage of time.
[0022]Similarly, the optimal focusing position may be changed in time influenced by the electromechanical various characteristics of fluctuation of an automatic-focusing doubling positioning device or distance sensors.
[0023]The purpose of this invention is to provide the automatic regulating method of the characteristic variable which suits especially when the variation speed of the various characteristics of a continuous picture is high in an optical code reading system.

MEANS

[Means for Solving the Problem]If this invention is followed, a method for adjusting automatically at least one characteristic variable of an optical agreement reading system characterized at the following steps is provided.
[0025]acquisition of a step a picture, and Step b -- at least one optical agreement in the picture is read, [try and] Step c -- verification of whether the reading was completed correctly, and Step d -- acquisition of the characteristic variable about the picture when that is right, and Step e -- change of at least one controlled parameter which acts on change of the acquired characteristic variable.
[0026]A characteristic variable (or quantity) is acquired suitably several times, an average statistical data is acquired about reading of a large number, and a real qualitative difference between continuous pictures is measured. Regulation is performed continuously and change of the characteristic of a reading system resulting from change of component parts of an environmental cause or an inside is monitored.
[0027]Display brightness and the focusing characteristic are contained in quantity of the characteristic adjusted, and a control parameter is chosen as it from a focusing position, picture acquisition sensitivity, a lighting output, a judgment threshold used for reading, and image scanning speed.
[0028]A control parameter, respectively and when a relation between each of the amount of characteristics is not known, This method changes a value of the present parameter with one positive small displacement and one negative small displacement at least from the current value, and assesses which [of the two displacement] gives better imaging quality. In continuing reading to lengthen, a value with a new control parameter turns into a center value. By repeating this process, it becomes easy to move a center value of a control parameter toward optimal position promptly, and it can monitor any change of-like at the time of a path of this position.
[0029]The further characteristic of this invention will become clear by explanation of a desirable embodiment which is given as completely un-restrictive illustration,

and is described with reference to the following accompanying drawings.
[0030]
[Embodiment of the Invention]By this invention, if it is possible only for the initial learning time (it is not assumed that the reading system is operating correctly in the meantime) when a reading system is specific to stand by, It becomes possible using an initial self-learning process to initialize the parameter of an optical agreement reading system, It becomes possible to change continuously the present regulation for fitting parameter value to the-like change at the time of the surrounding environment and the path of internal component parts further again using the optimized method (autogenous control).
[0031]In the embodiment of drawing 2 which follows this invention especially, there is an alternative step of initial setting of a parameter first (block 20). This step is manual, once a reading system is attached, it is carried out (or after maintenance discontinuation of component-parts exchange), but it can abbreviate to having already stated.
[0032]Then, the block 30 with which a picture including the optical agreement which should be inspected is acquired. in a reading process -- this article -- for the autogenous control at the time of a standard operation also for self-study in case a reading system carries out the operation start of this qualitative picture acquisition -- this article -- it is qualitative. It is peculiar to all the optical agreement reading systems, and picture acquisition is performed in accordance with the well-known method using CCD or CMOS type linearity or a matrix sensor, and supplies the analog or the digital electrical signal relevant to a luminance level of each dot (pixel) which forms a picture.
[0033]Then, the block 40 with which the acquired picture is analyzed. this analysis described below with reference to drawing 3 is unnecessary to regulation of a control parameter, when the purpose of trying the purpose of searching the present optical agreement (two or more optical agreements), decoding, or recognition, and a positive consequence come out in a picture -- it has the purpose which gains the image volume of shoes and is memorized appropriately.
[0034]The block 50 whose monitor of dynamic change of a reading system it is finally judged whether it is necessary to change the operating point of a reading (given by 1 set of present value of control parameter) system, and the initial self-study of is attained, or is attained. Although an operating point change step is explained below with reference to drawing 4 thru/or drawing 9, following on it, it returns to the block 20 and acquisition of a new picture is performed.
[0035]The step (block 40 of drawing 2) which analyzes the acquired picture is explained with reference to drawing 3. The block 70 which will search first the field which probably includes optical agreement within the picture which the handling unit 13 was gained and was memorized if it explains in full detail. This step is performed using the method of the common knowledge which searches for the field which has the biggest contrast within a picture, for example. Agreement is formed of an element or structure with a different color (for example, white and black), and it is because the specific repetitive shift of the

color is the purpose of coding.
[0036]. Then, a reading system verifies whether at least one agreement field was identified. The block 75, the block 85 which ends the analysis step 40 if not verified (NO output) and with which the 1st discernment agreement field (or only) will be chosen (block 80), and reading will be tried if verified (YES output). If the numerals which are performed by the well-known method according to the type of the numerals read and which are read especially contain the character, the trial of reading reading, If the bar code or the two-dimensional code performed based on the character recognition in a fully reliable method is contained, reading comprises coding of agreement by a method exact enough. For example, if the method usually used is followed in the case of a bar code, the existence of the element (bar) of a series of colors which carry out a repetitive shift will be verified, It is verified whether the number of elements becomes equal to one predetermined value after all, and the width of each element is measured, The width or conditions predetermined [at least] in those some (for example, whether they are related mutually.) or it has the given order -- **** -- it is verified selectively whether it fills or not, the series of the number corresponding to the repetitive shift of the detected element is determined, and it is judged whether it is the agreement whose conditions an obtained number of series suit.
[0037]Then, the block 90 with which it is verified whether reading was completed on the success reverse side. This step is dramatically important. It is because it is shown that the positive consequence of agreement reading has quality sufficient in order that the field currently examined may acquire the present value of a measurand (the statistical data used in order that it may adjust the value of a parameter will be specified if this invention is followed). the statistical data in which the field which is used in order that only the imaging range which guarantees good reading of optical agreement may change the value of a parameter, and which reading can be impossible or cannot fully be trusted on the other hand was actually obtained when following this invention -- the right -- things -- since it cannot guarantee, these fields are refused. As a result, if reading does not take place (NO output from the block 90) and there are no block 95 and other fields where it is verified how [from which other agreement fields were not detected in the searching step 70 of the same picture] it is, . NO output is taken out from the block 95 and end the image-analysis step 40. Otherwise, (the YES output from the block 95 where other fields exist and which has the possibility of the existence of optical agreement in the same picture there), and the continuing agreement field are chosen, the block 100 and reading are tried, and it returns to the block 35.
[0038]If reading is successful (YES output from the block 90), one copy of the agreement field identified before will be chosen, namely, it will specifically consider that the field is best about quality. The center portion of the optical agreement by which decoding is carried out especially is chosen suitably, and an edge effect is removed (block 105 of window extraction).
[0039]Then, the block 110 with which the exactly selected window is processed and the value of statistical data, i.e., a measurand, is gained. In particular, all the

measurands are measured and calculated in this step. all the indices of the modification of all the deviations from the predetermined value of a maximum brightness value (namely, white level in 2 color agreement measured as a gray level), a minimum luminance value (black level), an average level, signal average energy, and the rate of an agreement element and agreement shape to it -- ** is contained. On the luminosity scale especially contained between 0 and a 255 binary level, on relevant luminosity conditions, a white level is a binary value near 200, and a black level is [ten] near. Signal energy is calculable as square [of the amplitude of the differential coefficient of a luminance signal].

[0040]The block 115 with which every one statistical data calculated exactly is memorized on a suitable table about each variable. This statistical data is independently memorized suitably according to the distance (obtained from the height of the object in which that picture was detected) between an inspected object and the picture acquisition device 10. Because, it is preferred to memorize the number of the samples which are because the optimum value of a parameter is decided by this distance and from which these tables had been gained further so far, total value, and the average value calculated by dividing total value by a sample number. In practice, for every new acquisition, about each of the measured value, according to the value of the present height of an inspected object, one sample number is increased at a time, total value is updated, the newly gained value is applied to the pre- total, and average value is updated.

[0041]The table of two different types is constituted depending on the measurement variable examined, the parameter combined with it, and the characteristic optimized, and the details are explained below with reference to drawing 7 and 8.

[0042]If it is verified whether the further agreement field exists in a picture as already stated in relation to the block 95 and it does not exist after a statistical data table is updated (block 115), the image-analysis step 40 is ended.

[0043]Before explaining Step 50 for verifying the operating point in full detail, in order to optimize the characteristic of the method **** reading system of this invention, the mechanism for adjusting a parameter based on the gained statistical data is explained. Some characteristics (display brightness measured by the maximum and the minimum luminance value) actually, It has monotonous (it can know approximately correctly or at least) correlation to each of a control parameter (the amplitude profit of a picture acquisition device, and the output of the lighting part 12), for example, it is shown in drawing 4 showing the relation between the luminosity L and the profit G. Therefore, if based on a measurement variable value (the minimum and maximum brightness value) in this case, in order to optimize reading, it is easy to identify the amendment performed to the parameter value controlled. For example, after the predetermined number of acquisition, if all the agreement fields gained about specific height are dark colors (a predetermined value, for example, the maximum digitization luminance value lower than 180), it is required to increase a profit and/or to increase a lighting output (for example, voltage supplied to the lighting part 12).

[0044]Other characteristics like the focusing capability measured by the energy

of the electrical signal supplied by the picture acquisition device 10 in another side, It has more complicated correlation to each of a control parameter, and it is shown by drawing 5 showing the function which connects the position P to average energy E of for example, an automatic-focusing doubling device. In this case, in order to optimize reading, it is impossible to use directly the specific principle which connects a measurement variable and a control parameter (approximately [even if]). In the case of the function of the type in which a curve has absolute maximum and which is shown in drawing 5, the following problems actually exist.

[0045]As for the absolute value of the maximum A, the operating point which cannot judge whether the picture which was changed to the picture and was exactly acquired from the picture for the reason is best is left-hand side or on the right-hand side of (in drawing 5) the maximum. It is impossible to judge whether it is located in the point B or the point C of having the same ordinate, therefore in order to improve reading, it is impossible to determine in which direction a focusing position must be changed.

[0046]Therefore, in the case of the measurand combined with each of the control parameter in non-line type. By performing acquisition of a specified number accompanied by a change of the same desirable value positive and negative which made the value of the control parameter change slightly about the method of this invention, therefore the present setting out, While discernment of the bending point when the reading system was placed is attained, an alternative determination of the direction of the actual amendment of whether amendment is required judged and performed is attained. For example, if the system is located in the point C corresponding to the position P1 and the average energy E1 to acquisition of a specified number with reference to drawing 6 similar to drawing 5, Only displacement +J is changed first, the value of a position shifts to the position P2, and the average energy value E2 is obtained after acquisition of a specified number in this way, and an initial value is displaced. - Only J is changed, it shifts to the position P3, and the average energy value E3 is obtained in this way. In this case, since the optimal read condition corresponds to the maximum energy level, clearly, a result best in the 2nd setting out (- J) is given, and the center value of a control parameter must be become final and conclusive by P3 in this way.

[0047]Especially the absolute value of the displacement J must be large enough so that change of imaging quality may be discerned, however it must be small enough so that reading of optical agreement may not be barred. This displacement is suitably chosen within the interval between the minimum which makes possible verification of a characteristic variable and reading of optical agreement which were detected, and the maximum. It is because the direction of the displacement for autogenous control measurement taking place at the time of the normal system operation of a reading system, and optimizing operation is not identified, so it reads also about the displacement which is separating and moving from the optimal conditions and the function of a system must be maintained.

[0048]A change of a control parameter based on predetermined displacement is made for every acquisition of every acquisition or a predetermined number.
[0049]And in the case of the measurement variable and control parameter in monotonous correlation, in the data storage step 115, the table of the type of drawing 7 is used suitably. In the case of the measurement variable and control parameter in another side and un-monotonous correlation the sequence of total value is not indicated to be for simplification, the table of the type of drawing 8 is used there. There, sample number N (-J), N (+J) and calculated average energy E (-J), and E (+J) are shown about each of the value of objective height, and both displacement +J and -J.
[0050]The operating point is verified based on above-mentioned explanation, and the step (block 50 of drawing 2) changed selectively is explained with reference to drawing 9 about a single control parameter. However, Step 50 is repeated after each image-analysis step 40 about each of the control parameter of a reading system.
[0051]******** [that first a reading system is in the state of self-study in the block 150] (for the operating condition which should be examined, including the present distance between an inspected object and the picture acquisition device 10) It is verified whether initial setting which reads possible has not been found out yet, or it is in the state of good regulation. In the case of the 1st (YES output from the block 150), on the present operating condition, it is verified whether at least one proper agreement reading was performed (block 151). Otherwise, (NO output from the block 151) and a control parameter are set as the value which has not been used yet (block 150). The step of ****** food ****** between the self-learning steps to each acquired image which has not resulted by decoding of optical agreement, According to the predetermined scheme, it is designed scan all the values in which a control parameter is possible until setting out which makes agreement reading possible is found out in a specific operating condition. If agreement is correctly read by it, by it, a reading system will find out a series of permissible values about a control parameter. Succeedingly, it is further made exact based on statistical data so that it may explain in full detail below.
[0052]In order to set a focusing position as the height to which the object which supports the numerals read especially was given first, a reading system, In continuous acquisition, setting out of all the possible focusing positions is tried starting with initial setting (for example, random setting out in the position on which the automatic-focusing doubling device is put). For example, if the peculiar view depth of the optical system incorporated in the picture acquisition device 10 is common knowledge, the increment of the value of a position will be carried out only the value of the half of peculiar view depth every interaction with a negative output, or after the interaction of a predetermined number. In practice, in the 1st height (for example, 10 cm) using the 1st focusing value, If the output of this 1st trial by which reading of the 1st is tried to the 1st objective group as opposed to the 1st object that moves in the bottom of the device 10 is negative, ** -- in the 1st same height, reading of the 2nd is tried to the 2nd group of the 2nd object or an object using the 2nd focusing value. Other control parameters are set up

similarly, and in the completing point of the whole setting-out series for focusing, those initial values are similarly changed, when a series of setting out has not come to identify the series of the value which makes agreement reading possible, using the focusing value.
[0053]When the present setting out makes reading of agreement possible, the self-learning step to the height currently examined is interrupted by the basis of control by (the YES output from the block 151), and NO output from the block 150 (block 152), and a good regulation step is started. Even when the aforementioned process is repeated about all the objective possible height by it and initial manual setting is not performed, the 1st approximate value of each parameter is combined with each of height.
[0054]Step 50 which verifies the operating point behind to setting out of the parameter value in a self-learning step is ended, it returns to the block 30 of drawing 2, and the following picture is inspected.
[0055]If verification of the operating condition currently examined is completed on the other hand (NO output from the block 150), it will be verified whether enough statistical datas were gained about the parameter currently examined on the specific operating condition (block 165). For example, in order to avoid change which the parameter mistook in consideration of high image change nature, it is possible for the number of acquisition consider that is enough statistically to be included from 500 to 1000. If the output is negative (the insufficient number of acquisition, NO output from the block 165), If the result which completes Step 50 which setting out is not changed but verifies the operating point is affirmative (YES output from the block 165), it will be judged whether the parameter currently examined is combined by each, and the monotonous function or the more complicated function of the measurement variable (block 170).
[0056]In the case of the 1st (YES output from the block 170), It is judged whether in consideration of the present operating condition, the statistical data (average value) memorized on the table of drawing 7 about the variable combined with a control parameter is in "the optimal interval" expressed with delta of drawing 4 to which the operation which should be satisfied is performed (block 173). If the memorized average value is in the optimal interval (YES output from the block 173), when [which is not so] Step 50 which verifies the operating point completes any change nothing, each of (NO output) and a control parameter will be changed (block 175).
[0057]If a desirable briefer embodiment is followed, direct, then the block 175 will be carried out from the block 170 to a YES output, and a control parameter will be stably changed using the curve of drawing 4.
[0058]When a different parameter exerts an operation on one measurand (therefore, characteristic that reading systems, such as a profit, a lighting output, etc. in connection with luminosity, correspond), in the way which is not illustrated, In consideration of both parameters, the trial which changes the furthest parameter from the fluctuation limit first becomes possible. For example, about the above-mentioned parameter, as for a profit, when the lighting output has already approached the maximum to being still a low value, it is possible to make

only a profit increase first. Or it is also possible to apply a specific standard and to determine the quantity of which which parameter has changed, for example, it is possible to change two parameters by turns. Or it is also more possible to change both parameters simultaneously with a low value than being needed in change of one parameter.

[0059]. After a value with a new control parameter is set up, the number of acquisition (sample) to which it corresponds for the statistical data memorized before and an operating condition under consideration is reset. And the value with a new control parameter is an operation interval (a parameter is defined as a reference interval which may change within the limits of it, and). it completing, otherwise, (NO output) and alarm being started (block 185), because the step which changes the operating point, if that value compared within the block 180 is in this interval (YES output), it is because at least one component parts of a reading system are going to start the operation in the dissatisfied state (for example, the lighting part 12 is exhausted) clearly -- however, The reading system operates by the normal mode as much as possible, and it returns in order to acquire a new picture picture.

[0060]If it is monotonous-like [a control parameter], NO output will be taken out from the block 170, and a predetermined deviation will be applied as mentioned above with reference to drawing 6. If it explains in full detail, it will be verified whether the meant predetermined deviation was already applied first (it is [whether the average value of a measurement variable exists about both deviation +J of a control parameter, and -J, and] the block 190). Otherwise, the value of a control parameter is updated based on the deviation which has not been examined yet (block 200), and the step which verifies the operating point is completed. If the result is affirmative (YES output from the block 190), "the examined value" of the parameter throat which statistical stored data is inspected and is examined will detect whether a measurement variable is optimized. And this value is chosen and is set up as a center value of the control parameter for the continuing acquisition. To it, above-mentioned deviation +J and -J are applied (block 195).

[0061]Then, like the case of a monotone parameter, a statistical data and the gained sample number are reset to an operating condition under consideration, and it is judged whether it is contained in the operation interval which the new center value of the parameter meant with the execution step 180.

[0062]As opposed to the center value with which the statistical data was also before set up in addition to the statistical data to a predetermined deviation when the regulation to precede was completed as a substitute of the described process, It is gained and a decision relevant to continuing setting out is made in consideration of all (about a center value and all the meant deviations) the statistical data. Therefore, if the center value set up before is in the optimal prescribed interval, it will not be changed like the case of a monotone parameter. Then, all the statistical datas and corresponding sample numbers are reset to the operating condition under examination, and Step 50 which verifies the operating point about the parameter is completed.

[0063]The strong point of the described method is clear from the above-mentioned explanation. The optimization especially of this method to the continuous acquisition of-like at the time of a path which was external and was adapted for change of internal conditions is attained by this which predicts the acquisition parameter which should be set by performing statistical ********** about the picture which a large number precede. In the temporal analysis of change performed to the parameter for monitoring the optimal regulation especially. It becomes possible to decrease substantially the shutdown time of a reader which detects a situation before component parts deteriorate, and it becomes possible to emit the alarm which suited the right time, and originates in broken component parts, or to even remove it.
[0064]By using only the picture ("SAKUSE seeds") read by the success reverse side, It becomes possible to control an unsuitable or inaccurate change of the parameter which the data influenced by the data or probable error which using the data which is statistically meaningful was guaranteed, and was pulled out from specific conditions should be eliminated, therefore should be controlled. The reliability of this method and the convergency to the optimum value of a parameter increase by using only the primary importance portion of the read numerals.
[0065]In the case of the parameter combined with the complicated function accompanied by each measurand, Even when these complicated functions are not beforehand known by searching the optimal parameter by introducing a minor change into a present value, it becomes possible to acquire and maintain the optimal operating condition by the process of "trial and error."
[0066]It is possible to perform many corrections and change finally to the method which was explained here and illustrated, and those all of be [it / within the limits of this invention] are clear so that an attachment claim may be defined. It is emphasized that especially an above-mentioned method not only enables the optimization to ****** of focusing and the luminosity of a picture, but it is applicable to other parameters. For example, when verifying whether whether it being hard to accept the dimensional relation between agreement elements, and it being widely different from the reference value and an inaccurate change are followed, this method can be used in order to fit the threshold used for decoding. It can be used in order to amend the value of an objective scan speed. Since the initial setting given externally is due to the presumed speed of advance of the different conveyor belt 2 from a actual speed detected by the optical encoder 5, Or because of the temporal change in a mechanical carrier system, since it is not functionally enough any longer (therefore, acquisition of the perverted picture is caused), it may not be right.
[0067]However, generally, this method can be applied, when the acquired pictures differ greatly mutually. Therefore, when some fundamental parameters receive late fluctuation relatively compared with the acquisition frequency of a picture, And prediction regulation of a parameter needs to be performed, without the case that it is not possible to presume fluctuation of a parameter only using a sensor through a mathematical calculation, or where it is not convenient.

[Brief Description of the Drawings]
[Drawing 1]The figure showing an optical agreement reading system.
[Drawing 2]The flow chart showing operation of the method concerning this invention.
[Drawing 3]The flow chart showing detailed operation of a block of drawing 2.
[Drawing 4]The figure showing the function relevant to some parameters controlled in the system in drawing 1 accompanied by each controlled variable.
[Drawing 5]The figure showing the function relevant to some parameters controlled in the system in drawing 1 accompanied by each controlled variable.
[Drawing 6]The figure showing the function relevant to some parameters controlled in the system in drawing 1 accompanied by each controlled variable.
[Drawing 7]The figure showing a table effective in the method of this invention.
[Drawing 8]The figure showing a table effective in the method of this invention.
[Drawing 9]The figure showing the detailed flow of another block of drawing 2.
[Description of Notations]
1 [-- An optical code, 5 / -- An optical encoder, 6 / -- An existence sensor, 7 / -- A height sensor, 10 / -- A picture acquisition device, 11 / -- A sensing area, 12 / -- A lighting part, 13 / -- Handling unit.] -- An optical code reader, 2 -- A conveyor belt, 3 -- An object, 4

[Claim(s)]
[Claim 1]A method characterized by comprising the following of adjusting automatically at least one characteristic variable in an optical code reading system.
Step a which acquires a picture.
Step b tried in order to read at least one optical code in said picture.
Step c which verifies whether said reading operation was completed on the success reverse side.
Step d which detects said characteristic variable of said picture when having completed is verified.
Step e which corrects at least one controlled parameter which acts on change of said measuring-characteristics variable.

[Claim 2]A method according to claim 1, wherein said step e which repeat execution of said step a thru/or Step d is carried out, and gains a statistical data for two or more pictures by this, and corrects at least one characteristics parameter is performed based on said statistical data.
[Claim 3]A method of adjusting said at least one control parameter continuously by carrying out repeat execution even of said step a thru/or Step e according to claim 1 or 2.
[Claim 4]A method according to claim 3, wherein it is a value to which said parameter enables said minimum to correct only a daily dose between the minimum and the maximum and to evaluate change of said detected characteristic variable and said maximum is a value in which said step c to verify has a result of plus.

[Claim 5]A method according to claim 3 or 4 whenever reading is performed said step adjusted continuously, wherein it performs.
[Claim 6]A method according to claim 3 or 4 whenever reading is performed only the number of times predetermined in said step adjusted continuously, wherein it performs.
[Claim 7]A method of claim 1, wherein said characteristic variable is chosen from display brightness and focusing quality thru/or claim 6 given in any 1 paragraph.
[Claim 8]A method of claim 1, wherein said step which detects at least one characteristic variable contains a step which measures a value of width change of maximum luminance, minimum luminance, average luminance, luminance-signal energy, and a code element, and modification of an optical code at present thru/or claim 7 given in any 1 paragraph.
[Claim 9]A method of claim 1, wherein said at least one control parameter is chosen from a focusing position, picture acquisition sensitivity, a lighting output, a reading determination threshold, and image scanning speed thru/or claim 8 given in any 1 paragraph.
[Claim 10]A method comprising of claim 1 thru/or claim 9 given in any 1 paragraph:
A step to which said step d which detects at least one characteristic variable extracts a window from a field of said picture and to carry out.
A step which acquires said characteristic variable in said window.

[Claim 11]A method according to claim 10, wherein said window is arranged to said field at a center.
[Claim 12]A method according to claim 10 or 11 containing a step which localizes a field where said step b which tries reading includes an optical code in said picture.
[Claim 13]A method of claim 1 thru/or claim 12 given in any 1 paragraph that said step e which corrects at least one control parameter is characterized by including a step to which said control parameter verifies whether it has a monotonous relation to said characteristic variable.
[Claim 14]A method comprising according to claim 13:
A step which verifies whether said at least one characteristic variable is settled in a predetermined interval.
A step which corrects said control parameter when that is not right.

[Claim 15]A method comprising according to claim 14:
A step which acquires a center value of said control parameter.
A step which determines the 1st adjusted value of said control parameter obtained by carrying out the increment only of the 1st predetermined daily dose to said center value.
A step which acquires a picture read by at least one success reverse side.
A step which acquires the 1st weighted solidity of said characteristic variable from said 1st at least one picture, A step which determines the 2nd adjusted value of said control parameter obtained by decreasing only the 2nd

predetermined daily dose from said center value, A step which acquires a picture read by at least one success reverse side, When a step which gains the 2nd adjusted value of said characteristic variable from said 2nd at least one picture, and said 1st adjusted value of said characteristic variable are better than said 2nd weighted solidity, A step which changes said center value of said control parameter interrelatively to said 1st adjusted value of said control parameter, and updates said center value of said control parameter interrelatively to said 2nd adjusted value of said control parameter when that is not right.

[Claim 16]A method according to claim 15 that the said 1st and 2nd predetermined daily dose is characterized by a mutually equal thing.
[Claim 17]A method of it being large enough for said 1st [the] and the 2nd daily dose producing a measurable change of said characteristic variable, and being small enough to such an extent that the reading possibility of an optical code is not influenced according to claim 15 or 16.
[Claim 18]A method comprising of claim 15 thru/or claim 17 given in any 1 paragraph:
A step which acquires a picture read by 3rd at least one success reverse side after said step which acquires a center value.
A step by which the 3rd weighted solidity of said characteristic variable is acquired from said 3rd at least one picture, and said center value is not updated when said 3rd weighted solidity of said characteristic variable is better than said 1st [the] and the 2nd weighted solidity.

[Claim 19]A method of claim 13, wherein said step which detects a characteristic variable contains a step which memorizes a table thru/or claim 18 given in any 1 paragraph.
[Claim 20]A method according to claim 19 whenever said memory step is performed [a step which detects at least one characteristic variable], wherein it contains a sample number from which said characteristic variable was acquired, and a step which updates average value of said characteristic variable.
[Claim 21]A method according to claim 19 or 20 whenever a step which detects at least one characteristic variable is performed, wherein said memory step contains a step which updates each field of said table to each operating state.
[Claim 22]The generic claim 19th, wherein a step which corrects at least one control parameter contains further a step which resets said gained sample number and said average value of said characteristic variable thru/or a method of claim 21 given in any 1 paragraph.
[Claim 23]A method of claim 19 characterized by what said step which detects a characteristic variable contains a step which memorizes a table to each characteristic variable for including two or more characteristic daily doses thru/or claim 22 given in any 1 paragraph.
[Claim 24]A method of claim 1 performing a step which carries out self-study and sets up an initial approximate value of said at least one control parameter before said step a to the step e thru/or claim 23 given in any 1 paragraph.

[Claim 25]A method comprising according to claim 24:
Step f which acquires a picture in which said self-learning step has a test value of said control parameter.
Step g which tries reading at least one optical code in said picture.
Step h which intercepts said self-learning step and performs said step d and Step e when said reading operation is a success.
Step i which corrects said test value of said control parameter with the new test value which was not before used when said reading scan was unsuccessful, and
Step j which carries out repeat execution of said step a thru/or the ** step h.

[Claim 26]A method of claim 1 performing a step which verifies whether said control parameter has a permission possible value after said step which corrects at least one control parameter, and a step which generates an alarm signal when not had thru/or claim 25 given in any 1 paragraph.